THEMATIC OVERVIEW PAPER 24

Adaptation of WASH services delivery to climate change

and other sources of risk and uncertainty



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Cover Photo: Features images from the Water Supply and Sanitation Collaborative Council's (WSSCC) climate change advocacy postcards Don't let climate change WASHaway the progress, 2010.

Key WSSC messages

Left: The impact of climate change will be felt first and foremost through changes in the water sector: droughts and floods will become more frequent and severe (PHOTO shutterstock/Galyna Andrushko)

Centre: Climate change adaptation measures must be developed to reduce vulnerability of communities regarding access to WASH services (PHOTO shutterstock/Jakez)

Right: To achieve the MDGs in water and sanitation, we must take the impact of climate change into consideration (PHOTO shutterstock/Asianet-Pakistan)

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Acronyms

CA	Comprehensive Assessment (*of water management in agriculture*)
CapEx	Capital Expenditure
CapManEx	Capital Maintenance Expenditure (*for “software” and “hardware”)*
CoC	Cost of Capital
COP	Conference of the Parties
CPWC	Co-operative Programme on Water and Climate
CSES	Center for Science in the Earth System
ExpDS	Expenditure on Direct Support
ExpIDS	Expenditure on Indirect Support
FAO	Food and Agriculture Organization (*of the United Nations*)
GIS	Geographic Information System
GLAAS	Global Annual Assessment of Sanitation and Drinking-Water
HRD	Human Resources Development
ICID	International Commission on Irrigation and Drainage
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWA	International Water Association
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
M&E	Monitoring and Evaluation
MUS	Multiple Use Systems
NAPA	National Adaptation Programme of Action
NGO	Non-Governmental Organisation
OECD	Organisation of Economic Co-operation and Development
O&M	Operation and Maintenance
OpEx	Operating and minor maintenance Expenditure
PCM	Project Cycle Management
PRA	Participatory Rural Appraisal
QIS	Qualitative Information Systems
RIDA	Resources, Infrastructure, Demand and Access
SMART	Specific, Measurable, Achievable, Realistic, and Time-bound
TOP	Thematic Overview Paper
UNICEF	United Nations Children’s Fund
USAID	United States Agency for International Development
VFM	Value for Money
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WWC	World Water Council

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Executive summary

Climate change has the potential to impact on both the supply and demand sides of Water, Sanitation, and Hygiene (WASH) delivery systems. Some potential impacts are likely to be direct and very obvious (e.g. increased incidence of extreme floods that damage WASH infrastructure), whereas others are likely to be indirect, insidious and more uncertain in nature and severity (e.g. sea level rise leading to out-migration from coastal areas). Just as importantly, potential climate change impacts may be exacerbated by other changes that are also subject to a high degree of uncertainty (e.g. increased competition for safe water between the WASH and agricultural sectors).

Until December 2009, a large majority of the scientific community and most politicians would have agreed that scientific evidence of human-induced climate change should, at the very least, be given serious consideration. Since then, however, the Intergovernmental Panel on Climate Change (IPCC) has admitted that there were errors in their Fourth Assessment Report. This, coupled with the furore over hacked e-mails between climate scientists at the University of East Anglia, has provided climate change sceptics and some people in the media with ammunition to undermine public confidence in IPCC conclusions and climate science in general. Whatever happens next in this debate, one thing is for sure - it is likely to take some time before the current levels of public scepticism reduce to pre-December 2009 levels.

So, where does this leave the WASH sector? Put starkly, the choice facing WASH professionals is to take some action on climate change adaptation or to continue to ignore, or possibly just pay lip-service to the threat posed by climate change. This paper demonstrates that uncertainty and scepticism around the potential scale, nature and timing of climate change impacts should not be used as an excuse for inaction within the WASH sector. The paper adopts and recommends the now widely held view that climate change should be treated as one of many sources of risk and uncertainty, with the potential to impact upon WASH services delivery. This view recognises that, in addition to climate change, there are many important and uncertain threats to sustainable and equitable WASH services delivery. Furthermore, in some regions of the world, there are threats to WASH services that are more real and immediate than the ones posed by climate change. For example, the increasing scarcity of unpolluted water (as indicated by an imbalance between water supply and demand) is a severe threat to WASH services in many semi-arid regions that are experiencing rapid population growth and urbanisation.

This Thematic Overview Paper (TOP) is targeted at WASH professionals and practitioners who recognise the need for climate change adaptation but are not sure what to do or how to plan for it, and/or who themselves, may already be struggling with major challenges in improving or maintaining current WASH services. This TOP recommends a range of practical and well-proven methods and tools for managing risk and uncertainty linked to climate change and other factors for WASH practitioners to use. These methods and tools are described in the second section of this TOP. The approach recommended is based on three principles, consistent with statements arising from the 2009 UN Climate Change Conference in Copenhagen.

Part One
Climate change and the WASH sector

1 Introduction

1.1 What are the aims of this TOP?

This TOP is organised in two parts. The aim of the first part is to provide an overview of the relevance of climate change to the WASH sector and the current response of the sector to climate change. It outlines and recommends steps that the WASH sector may consider in order to better adapt to the potential impacts of climate change. The second part demonstrates how the WASH sector has been slow to adopt and mainstream simple and well-proven methods and tools for prioritising and managing risk and uncertainty (e.g. adaptive management, scenario planning). In addition to describing these methods and tools, it offers an analysis that describes the links between effective climate change adaptation and major improvements in WASH governance systems. In this part, the authors argue that, when prioritising and managing risk and uncertainty, specific attention should be given to sources of risk and uncertainty that are most important, most uncertain and outside the control of those responsible for any given WASH delivery system. The reason for this is that these “external factors” have the potential to disrupt even the most sophisticated strategies or plans.

This TOP primarily focuses on the water supply component of WASH services delivery to rural users. Furthermore, many of the issues discussed in this paper are equally relevant for urban users and in other programmes that seek to improve sanitation and hygiene services delivery.

1.2 What is the current response of the WASH sector to climate change?

Whilst there is growing recognition of, and attention to, the issues of climate change in the media and at international meetings (e.g. Istanbul World Water Forum 2009, Copenhagen COP15 2009, Cancun COP16 2010), WASH sector professionals and practitioners have been slow in tackling the issue of climate change. Why does this disconnection exist?

The WASH Sector is busy working on "more immediate challenges". Many WASH professionals and practitioners continue to struggle with the more immediate challenges of improving WASH services provisioning. The current low levels in water provisioning take place under conditions of a rapidly increasing demand for WASH services linked to population growth, increasing inter-sectoral competition for limited water resources, and slippage of WASH service levels due to factors such as inadequate operation and maintenance (O&M).

Climate change is regarded as "somebody else's problem". There seems to have been a gradual shift from WASH professionals and practitioners doubting that climate change poses a risk to WASH services delivery, to taking the stance that climate change is a potential hazard, but is "somebody else's problem". This view is reinforced by the fact that WASH professionals and practitioners tend to be excluded from climate change research and in the development of, for example, National Adaptation Programmes of Action (NAPA), which are usually under the remit of national ministries or departments of environment.

Governance constraints. Governance systems in the WASH sector are based primarily around allocation of funds followed by engineering works that are planned using standard specifications and procedures. These standard procedures, in particular, often put severe constraints on WASH professionals and practitioners who might want to adopt a more evidence-based and/or adaptive approach to WASH services delivery.

Lack of political will. There is a tendency now for politicians (and even WASH professionals) to blame the problems of WASH services delivery on climate change, often with no clear justification. Similarly, climate change has also become a convenient "scapegoat" for WASH services providers in explaining poor services delivery. Paradoxically, these same politicians often lack the will to approve expenditure on climate change adaptation.

Not sure what to do. As mentioned above**,** WASH professionals and practitioners tend to focus their energies in responding to the more "traditional" challenges of WASH services. At times, taking on new responsibilities and delving into new analytical terrain are feared to cause delays in meeting their immediate targets. As a result, they are not sure what they can do or how to contribute to climate adaptation without compromising other activities. This TOP was prompted in part by the lack of practical "what to do" guidelines targeted specifically at WASH sector practitioners.

Wait and see. Finally, there appears to be a large percentage of WASH professionals and practitioners who assume a "wait and see" attitude in responding to the links between climate change and WASH services. Put another way, whilst they do not deny the potential risks posed by climate change, they fail to recognise the imperatives for taking immediate action or modifying existing procedures. This general attitude may be attributed to a range of factors including confusing messages and signals from international meetings (e.g. the Copenhagen COP15 and Cancun COP16 meetings), lack of awareness of what may be done, resistance to change and/or uncertainty linked to the professional risk of being an early adopter of new analysis and ways of working. Media portrayal and reporting that question the veracity of the IPCC process and findings also prompt many WASH practitioners to adopt a "wait and see" strategy, which is deemed as the most "sensible thing to do".

1.3 Contents

The TOP is divided into two parts and five sections. Readers may wish to read sequentially through the whole document or dip into the sections of interest to them.

Part One

Section 1: This section describes the aims of the TOP and discusses some of the reasons why WASH professionals and practitioners refrain from giving climate change adaptation high priority.

Section 2: This section provides an overview of the current state of climate change knowledge in the WASH sector. The potential direct and indirect impacts of climate change on the WASH sector are discussed, as are the multiple reasons for climate change impacts being subject to such a high degree of uncertainty. Finally, this section draws attention to practical recommendations that, if followed, have the potential to reduce the vulnerability of WASH services delivery to potential climate change impacts.

Section 3: This section presents adaptation principles that can guide the development of strategies aimed at, for example, improving the resilience of WASH delivery systems. Given the crucial importance of improving governance in the WASH sector and wider water sector, the rest of this section focuses on offering practical recommendations for improving governance. The section concludes by discussing the major challenges in promoting and managing change in water governance policies and practice in the WASH sector.

Part Two

Section 4: This section provides an overview of practical methods and tools, and suggests an overall framework that WASH professionals could use to manage risk and uncertainty. Whilst the focus is on climate change, the approach presented here may help inform ways on how to tackle and prioritise the wide range of threats to WASH service delivery in a specific area. The logic behind this is that, in many areas, the threat posed by climate change is one of many important threats that need to be considered when rehabilitating old delivery systems (hardware and software) and/or planning and managing new delivery systems. Rather than being overly prescriptive, this section also presents principles that WASH professionals can consider adopting when deciding on an approach to climate change adaptation that best suits the aims of their work.

Section 5: This section provides a detailed description of well proven methods, tools and frameworks that are not in regular use in the WASH sector but are particularly relevant to managing risk and uncertainty (including climate change). The section aims to answer practical questions such as: What is the aim and benefit of using each method or tool? What are the generic steps or processes that could be followed? What are the pitfalls and/or practical lessons that have already been learnt from using these methods and tools?

2 Climate change and water: current state of knowledge

2.1 IPCC report on climate change and water (2008)

The opening statement of the last report of the Intergovernmental Panel on Climate Change on climate and water asserts that: 'Observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems' (Bates, et al., 2008). The main findings in the 2008 IPPC report on water resources were summarised by Batchelor, et al., (2009) as follows:

- Precipitation will increase in high latitudes and parts of the tropics, and decrease in some subtropical and lower mid-latitude regions.
- Annual average river runoff and water availability are projected to increase in high latitudes and in some wet tropical areas, and decrease over some dry regions at mid-latitudes and in the dry tropics.
- Increased precipitation and variability intensity will increase the risks of flooding and drought in many areas.
- Water supplies stored in glaciers and snow cover are projected to decline as will dry-season river flows based on snow melt.
- Higher water temperatures and changes in extremes, including floods and droughts, are projected to affect water quality and exacerbate many forms of water pollution.
- Global mean sea level has been rising.
- Climate change challenges the traditional assumption that past hydrological experience provides a good guide to future conditions.

A more recent review of climate change science was carried out by the United Kingdom Royal Society in 2010. This review is notable in part because of the precise and measurable recommendations it makes. Also, it provides rich material developed by many well-respected scientists who are not directly involved in climate change research. The findings of this review that are relevant to the WASH sector include:

- There is strong evidence that the warming of the Earth over the last half-century has been caused largely by human activity, such as the burning of fossil fuels and changes in land use, including agriculture and deforestation. The size of future temperature increases and other aspects of climate change, especially at the regional scale, are still subject to uncertainty.
- There is very strong evidence suggesting that climate change has occurred over a wide range of different timescales from decades to many millions of years; human activity is a relatively recent addition to the list of potential causes of climate change.
- Climate models tend to predict that precipitation will generally increase in areas with already high amounts of precipitation and generally decrease in areas with low amounts of precipitation.
- Because of the thermal expansion of the ocean, it is very likely that for many centuries the rate of global sea-level rise will be at least as large as the rate of 20 cm per century observed over the past century. There is currently insufficient understanding of the enhanced melting and retreat of the ice sheets on Greenland and West Antarctica to predict exactly how much the rate of sea level rise will increase above that observed in the past century for a given temperature increase.
- The ability of the current generation of models to simulate some aspects of regional climate change is limited, judging from the spread of results from different models. There is also little confidence in specific projections of future regional climate change, except at continental scales.
- Like many important decisions, policy choices about climate change have to be made in the absence of “perfect knowledge”. Even if the remaining uncertainties were substantially resolved, the wide variety of interests, cultures and beliefs in society would make consensus about such choices difficult to achieve. However, the potential impacts of climate change are sufficiently serious that important decisions will need to be made.

Complexity aside, three important conclusions can be drawn from these two summaries.

1. There are good reasons for the WASH sector to be concerned about the potential medium and long-term impacts of climate change.
2. The WASH sector should become more actively involved in climate change research and debate.

3. There is a great deal of uncertainty in the findings even at the global and continental scales. This uncertainty increases as spatial scales decrease to those at which most WASH planning processes take place (e.g. the local, district or regional scales).

2.2 Why is there so much uncertainty in climate change predictions?

There is no escaping the fact that uncertainty and climate change go hand-in-hand. Despite decades of ever more exacting science on different aspects of global warming, there remains great uncertainty on just how much warming will occur and, more specifically, on rates of atmospheric warming over different land surfaces. There is even more uncertainty in the global climate and modelling systems that are used to predict the effects of greenhouse gas emissions on rainfall and other climate variables at various spatial and temporal scales. This uncertainty is linked to inadequacies in the way these models describe complex physical processes, to problems of scale[1], and to quality of information used to develop or drive these models. It is also highly unlikely that some uncertainties will ever be reduced because of, for example, the lack of observations of past changes relevant to some aspects of both climate forcing and climate change (Royal Society, 2010).

The way in which changes in future rainfall amount and intensity affect surface runoff and groundwater recharge depends on simultaneous changes in evaporation, but as importantly, on changes in a multitude of additional factors that include: land use and land cover, cropping intensity of rain-fed and irrigated crops, and groundwater levels. The local water balance (how rainfall at a particular place becomes divided between surface runoff and infiltration, and then between evaporation and groundwater recharge) is very sensitive, not only to changes in climate, but to changes in soil properties, agricultural practices or land use. It has to be recognised that change in agricultural practices, and associated change in the patterns of demand for and use of water, may be induced by climate change and/or a wide range of semi-dependent causal factors such as increasing demand for agricultural commodities.

To make the situation even more complicated, there is the potential for all kinds of feedback loops that have the potential to exacerbate (or possibly reduce) potential climate change impacts. Such feedback loops from (mal) adaptation measures to climate change are not fully considered in current predictions (Bates, et al., 2008). As a consequence, the prediction with any certainty of the impact of climate change on,

[1] Many physical processes are scale-dependent and, as a result, uncertainties are unavoidable if data or model outputs are up or down scaled.

for example, the frequency and intensity of extreme events (e.g. flooding) in space and time becomes both complex and incredibly difficult. It is, therefore, highly unlikely that reliable predictions of changes in water supply and demand will be available in the foreseeable future, particularly at the scales at which WASH planning generally takes place.

It has been argued in open meetings (including the 2009 Stockholm World Water Week) that uncertainty linked to science is relatively small compared to uncertainty linked to the wider political economy. Various sources of uncertainty are listed below (Pahl-Wostl, C., Möltgen, J., Sendzimir, J. and Kabat, P., n.d.):

- Uncertainty linked to knowledge (e.g. scientific understanding).
- Uncertainty linked to societal and bio-physical systems (e.g. the complex feedback loops and/or delays that might exacerbate or reduce the impacts of climate change).
- Uncertainty linked to system behaviour and, more specifically, the ability of systems to adapt and cope with (or even prosper from) climate change impacts.
- Uncertainty in the perceptions (or mental models) that institutions or people have of climate change. These are and will continue to be diverse, ambiguous and difficult to reconcile.
- Uncertainty in the potential impacts of policy, frameworks, methods and tools aimed at practical adaptation. It is expected that recommendations offered by this TOP will lead to some provocative outcomes. This is the inevitable result of new initiatives and changes in practice, not least because there will always be individuals or groups who use the opportunity provided by change for self-improvement and/or capturing power.

2.3 Is climate change already having an impact on WASH service delivery?

According to the World Health Organization (WHO) and UNICEF Joint Monitoring Programme, the current state of water supply and sanitation services worldwide is a source of concern in several respects (WHO-UNICEF, 2009):

- Globally, 1 billion people are currently without access to improved water supply and 2.6 billion have no form of improved sanitation services. Most of these people live in Asia and Africa. In Africa, for example, two out of five people lack access to an improved water supply.

- Significant disparities exist between rural and urban services, which continue to contribute to the burden of life in rural areas. People who live in the informal, overcrowded peri-urban settlements spawned by urbanisation also have especially low coverage.
- Increasingly, surface and groundwater sources are being polluted by pesticides, and by untreated industrial and household wastewaters.
- The over-extraction of water for agriculture and manufacturing, which causes the water table to decline, is another bad practice, which threatens the sustainability of water services delivery in many parts of the world.

The media's reaction to extreme events (e.g. droughts, floods, hurricanes) suggests that every event provides additional evidence that climate change is taking place. Similarly, there is a worrying trend of an increasing number of WASH service providers who attribute challenges to service delivery to climate change, in attempts to deflect any criticism to their work and approach. This type of attribution goes against the widely-held view that the important causes of current WASH service provision problems have little or nothing to do with climate change. Rather, they are caused by the convergence of a range of factors that include: poor governance, lack of capacity, urbanisation, rising populations, increasing competition for limited safe water resources, lack of accountability and insufficient expenditure on operation and maintenance of services.

As the recent *Global Annual Assessment of Sanitation and Drinking-Water Report* (UN Water, 2008) indicates, 'the capacity of the WASH sector to even carry out its core mandate of service provision is very poor, particularly at the decentralised (local government) level'. This situation has prompted many to adopt a view similar to that expressed in the draft Climate and Water Report from the 2008 World Water Week: 'The relative impact of climate change needs to be considered against the demands and threats to water resources from increasing wealth and consumption, and growing populations' (Pittock, Teutschbein and Törnqvist, 2008).

Despite a general recognition or view that climate change is not currently impacting significantly on WASH services delivery, there is no excuse for inaction, nor to doubt that climate change poses a significant medium and long-term threat to sustainable, equitable and efficient WASH services delivery.

2.4 How might climate change impact on WASH service delivery?

There is also growing recognition that climate change impacts on both the supply and demand sides of WASH systems. Sinisi and Aertgeerts (2010) assert that WASH service providers should prepare for the widely anticipated consequences of floods and droughts, or risk compromising access to safe drinking water and adequate sanitation for a substantial number of people in developing and developed countries, with cascading effects on human health, the environment and development.

Table 1 tries to summarise potential direct and indirect impacts of climate change on the different components of water supply systems using the Resources, Infrastructure, Demand and Access (RIDA) framework schematic. The RIDA framework has been used because it highlights the fact that water sources (i.e. resources) are linked to the demands of users by supply (and water treatment) infrastructure. The access component is used to emphasise the fact that user access to WASH services is often less than the demand as quantified in terms of politically-acceptable norms. Table 1 (on next page) draws attention to two important points:

- Climate change impacts on both the supply and demand sides of WASH delivery systems are variable and unpredictable.
- Some impacts are likely to be direct and very obvious (e.g. increased incidence of extreme floods that damage WASH infrastructure), whereas others are indirect, insidious and more uncertain in nature and severity (e.g. sea level rise leading to out-migration from coastal areas).

Table 1 Potential direct and indirect impacts of climate change

Resources /Natural environment		Infrastructure		Demand		Access	
Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect
* Increased rainfall in high latitudes and parts of the tropics, decreasing in some subtropical and lower mid-latitude regions * Increased precipitation intensity and variability enlarging the risks of flooding and drought in many areas * Reduced water supplies stored in glaciers and snow cover * Heightened water temperatures, affecting water quality and exacerbating many forms of water pollution * Rising global mean sea levels, contributing to saline intrusion in coastal aquifers * Increased frequency of extreme temperature changes (hot and cold)	* Land use change and agricultural intensification leading to changes in hydrology at local and basin scales *In areas with lower levels of rainfall, water quality of rivers and groundwater is decreased leading to a reduction in dilution of pollutants * Increased unsustainable use of surface and groundwater resources *In areas with groundwater-level decline, rising levels of groundwater pollution from natural contaminants may occur (e.g. fluoride, arsenic) *Warmer and damper conditions leading to increased incidence of water-borne diseases	*Larger investments required for flood protection and re-engineering of dam spillways *Larger investments needed to increase storage capacity, supply and treatment systems *Major investments needed to supply WASH services to people migrating from flooded coastal areas or areas of absolute water scarcity *Destruction of WASH infrastructure and contamination of groundwater as a result of localised flooding *Increased energy costs that may facilitate a shift to low carbon policies, leading to major increases in operating costs of WASH systems	*Anarchy leading to water theft and major damage to reticulation systems *Breakdown in law and order at water supply points as a result of conflict between migrants and existing users *Increased investment to irrigation infrastructure to enhance food supplies leading to less water for urban use *Heightened levels of expenditure on WASH infrastructure accompanied by low levels of financial accountability in response to WASH crises	*Increased demand for safe water resulting from prolonged drought, rising temperatures, etc *Increased demand for multiple use systems (MUS) activities (e.g. for livestock as a result of failure of traditional water sources) *Heightened demand for irrigation and rain-fed farming (also includes increased demand for irrigated biofuels) increasing competition between WASH and agricultural sectors	*Reallocation of water from agricultural to urban use leading to social unrest in rural areas and decreased food production *Increased interest in all types of demand management, regulatory instruments, etc *Increased water demand placing greater stress on ecological flows and habitat protection *Increased water demand leading to greater challenges to water treatment and sewage sludge disposal	*Added pressure towards ensuring sustained access to WASH services while keeping in line with established norms during periods of drought * WASH service provisioning becomes even more problematic, especially for the poor and disadvantaged (e.g. groups living in areas affected by flooding or sea levels rising) *Increased reliance on unregulated systems of water provisioning by private vendors *Reduced allocation of water towards the protection of the ecosystem	*Multiplication of livelihood problems as a result of rapid climatic change, making adaptation more difficult, if not impossible *Heightened competition over water resources -- potentially benefitting the elite *Possible failure of regulatory systems and/or legislation aimed at protecting rights of individuals or community to access water for different uses

Source: Own elaboration (2011).

2.5 What can and should be done?

Clearly, climate change adaptation is attracting considerable attention in the media and in academic and political circles. Leaving aside the hype and brinkmanship that is common in the media and political negotiations (e.g. as part of the Copenhagen COP15 negotiations), debates and discussions during international meetings have been focusing more and more on what can and should be done, particularly at the strategic level. This may be because climate change discussions have moved perceptibly into the mainstream, and as the potential nature and scale of climate change impacts are better appreciated. For example, statements emerging from conferences in Nairobi and Stockholm during 2009 provide good examples of international strategic level discussions on adaptation to climate change (Ministry of Foreign Affairs of Denmark, 2009; SIWI, 2009). Both statements recommend that well-conceived integrated water resource management should be the overall water governance framework within which climate change adaptation should take place. The other principles in the Nairobi statement are summarised in Box 1. The overall approach presented in this paper takes account of and attempts to build on the principles articulated in these statements.

Box 1 Nairobi statement on land and water management for adaptation to climate change Nairobi, 17 April 2009.

The principles in the Nairobi statement are summarised as follows:

Development: Adaptation must be addressed within a broader development context, recognising climate change as an added challenge to reducing poverty, hunger, diseases and environmental degradation.

Resilience: Building resilience to ongoing and future climate change calls for adaptation to start now by addressing existing problems in land and water management.

Governance: Strengthening institutions for land and water management is crucial for effective adaptation. Efforts to strengthen institutions must build upon inclusive principles that ensures the participation of civil society and facilitates gender equality, subsidiarity and decentralised operations.

Information: Information sharing and dissemination on local adaptation must be improved, and must be considered a public good.

Economics and Financing: The costs of inaction and the economic and social benefits of adaptation actions demand for increased and innovative financing.

3 How should the WASH sector prepare for potential climate change impacts?

3.1 Main adaptation principles

This section details the adaptation principles applied by water-using sectors, such as agriculture. These are based on documentation prepared for the Fifth World Water Forum in Istanbul (WWC, CPWC and IUCN, 2009):

First, WASH sector professionals should treat climate change as one of many sources of risk and uncertainty that impact upon sustainable WASH delivery service and access. A direct consequence of adopting this principle creates the necessary structure that incorporates climate change as a priority issue in WASH governance processes. Understandably, prioritisation of climate change varies from place to place. If more immediate and/or more threatening sources of risk and uncertainty are identified in any given domain of interest, these are given priority over climate change when, for example, developing coping strategies.

Second, given that the impacts of climate change are determined by the consolidation of a wide range of factors, it is not possible to develop an all-encompassing strategy for climate change adaptation. Despite this, there are some straightforward actions and interventions that could be considered in many contexts. These include increased funding directed to facilitating a given community's/area's resilience against droughts, or the enforcement of stricter planning regulations on locating WASH infrastructure in flood-prone areas. These, however, must be accompanied by informed and evidence-based research and a "learning-by-doing" approach that identifies and evaluates adaptation strategies.

Third, effective adaptation to climate change requires improvements in WASH governance. The next section identifies some areas in which WASH governance could and should be improved.

3.2 The challenge of improving water governance

There are certain water governance challenges that are linked specifically to climate change. These include:

- **Coping strategies may fail.** Many traditional coping strategies in the WASH sector may inadequately or completely fail to respond to the direct or indirect impacts of climate change. This is understandable considering that many of these were developed paying very little (or no attention at all) to climate change.

It may also be possible that the utility of many traditional coping strategies have declined as a result of environmental changes including for example, increasing population density, water scarcity or competition over good-quality water resources.

- **Risks from high impact, low probability events.** Many potential outcomes and impacts of climate change are difficult to predict. Sometimes referred to as "black swan"[2] events, the probability for these events to take place is low. However, should these occur, they may have disastrous or life-changing consequences, with the potential to disrupt existing WASH delivery strategies and efforts to improve the resilience of delivery systems. In such situations, disaster preparedness is crucial. Setting up appropriate procedures and training mechanisms that capacitate staff to protect and guarantee the survival needs of communities (e.g. water, sanitation and medical services) are core to disaster preparedness. In line with this, preventative actions have to be taken to counteract health hazards linked to water scarcity, infectious diseases and chemical and biological contamination of food and water (Sinisi and Aertgeerts, 2010).

- **Norms may be different.** Accepted norms and expectations from WASH services delivery or disaster relief may have to be modified to better meet the impact of climate change.

- **New capacities and attitudes have to be developed.** Mainstreaming climate change into planning processes requires capacity building and implementing changes at all institutional levels, but particularly at decentralised level.

- **Public funding flows will need to be changed.** Increasing resilience to climate change requires prioritisation and re-allocation of funds.

The potentially life-changing impact of climate change poses difficult challenges to existing political arrangements and administrative systems created to respond to time-bound and place-specific problems and realities. Clearly, there now is a need to revisit these arrangements and systems, modifying them to incorporate climate change mitigation and adaptation (Meadowcroft, 2009). The option pursued by most states had been to hand the remit for climate change to environmental departments on the basis that climate change is an environmental problem and the regulation of carbon dioxide (CO_2) emissions remains core to the state's policy response to climate change. However, there are significant problems with this approach in relation to the cross-cutting nature of climate policy and the different challenges posed by

[2] For more information on the importance and nature of "black swan" events, see http://www.fooledbyrandomness.com.

mitigation and adaptation. Structurally, environmental departments and organisations are often to be found in the periphery of the water sector, whilst institutions related to, for example, WASH services delivery (and often irrigation services), form the centre. In general, environmental departments are found to have relatively smaller budgets, are considered weak, with minimal influence and political clout, and are observed to have limited appreciation for core water sector disciplines that relate to engineering and WASH services delivery. All these factors combined have limited the possibilities for the WASH sector to engage in and make contributions towards the preparation of National Adaptation Programmes of Action (NAPAs) and, as a consequence, the sector in most countries has little ownership or respect for these programmes.

Second, although there is general agreement amongst academics and most water sector professionals to employ a “learning oriented” approach in climate change adaptation, government officials are often reluctant to develop plans based on these terms (Meadowcroft, 2009). This adds another layer of complexity in linking climate change adaptation with attempts to improve water governance. Governments tend to be wary of adopting “experimental” or “adaptive” approaches to policy development. This is explained by anxieties caused by the unknown and the impact of measuring the “uncertain” during independent appraisals that assess the effectiveness of policy and government operations. In general, the norm is for governments and other developmental actors to arrive at firm solutions to policy problems. A practical challenge therefore is to identify ways on how to increase understanding on the relevance of a learning oriented approach to public policy development in situations of pervasive uncertainty.

Third, the climate change discourse is often characterised by pronouncements that the world is headed for imminent catastrophe. Several international meetings have also profiled themselves as the (next) last opportunity to save the world. It has been observed that an element of fear or alarm is inherent in defining and acknowledging the size of any problem. It is also often argued that politicians and civil society need to be shocked or frightened in order to take the necessary steps to changing normative attitudes and practices. But does a governance discourse, based on negativity and trepidation, help the cause of climate change adaptation? There is also a risk that doom and gloom predictions will become a self-fulfilling prophecy if water sector professionals do not believe that their efforts to develop and implement adaptation strategies have a good chance of successful outcomes. Clearly, a balance needs to be struck. WASH sector professionals may need to be shocked or goaded into action, but they must also continue to maintain a positive mental attitude when developing and implementing adaptation strategies to climate change and other sources of risk and uncertainty.

Finally, the water sector as a whole needs to play a more central role in climate change adaptation, particularly at the national level. This, however, is both stating the obvious and glossing over the less than impressive outcomes of attempts during the last twenty-five years to improve WASH sector governance and introduce reforms that shift sector governance to more integrated and adaptive approaches to WASH services delivery. There are optimists who believe that the spectre of climate change might provide the necessary stimulus that kick starts significant changes in improving water governance and, just as importantly, the better alignment of policies across all the sectors that have a significant stake to safe drinking water, adequate sanitation, human health, the environment and development.

3.3 What steps can be taken to improve WASH governance?

3.3.1 Strengthening capacity particularly at decentralised levels

Capacity building efforts need to focus both on strengthening the systems and structures for governance, as well as the capacity for planning based on adaptive management and integrated water resource management (IWRM) principles. Capacity, or rather the lack of capacity in the WASH sector, is a key issue and often a limitation to tackling both immediate and long term challenges. Significant improvements in the WASH sector will not be achieved without strengthening capacity, irrespective of the additional challenges posed by climate change. Hence, any attempt to address climate change must grapple with the operational realities of capacity and other resource constraints, particularly at the intermediate and local levels.

Those involved in climate change research play an important role in capacity strengthening. This may entail the ability to present coherent information in forms and formats that can easily be understood by non-water specialists. Providing realistic estimates of confidence levels in managing and assessing information is another area for intervention. It is also important that, whenever possible, information is organised according to scale, relevant to the typical method employed by the WASH sector in informing decision making and planning. Organising information according to scale makes it possible for information to be selectively used in scenario planning at different institutional levels (e.g. local, intermediate).

3.3.2 Evidence-informed planning based on stakeholder dialogue

The WASH sector has been relatively slow to make that shift towards evidence-informed planning that involves the active participation of users and providers. As a result, delivery systems are seldom planned in ways capable of achieving the service levels required by users themselves. WASH sector planning continues to be heavily informed by a technocratic approach to planning and is organised based on budgetary allocation and engineering designs. Typically the sequence is as follows:

- Funds are made available to a WASH implementing agency for a given area or population.
- If the funds are not sufficient for the whole area, priorities are set on the basis of certain criteria.
- Plans are drawn up, often following (official) procedures dictated by a funding agency or a government.
- Construction and rehabilitation works take place in conjunction with relevant institutional development and capacity building.

3.3.3 Identifying and mapping vulnerability

Identifying and mapping vulnerability is a first step taken in allocating targeted expenditure and designing actions specific to regions and/or user groups (including ecosystems). In some cases, no or low regrets funding may be directed towards more vulnerable areas that may include low-lying areas (e.g. coastal and delta areas) or areas faced with water scarcity (i.e. areas in which demand for water exceeds supply). Such mapping can be quite theoretical and top-down in nature. Instead of relying on the outputs of complex climate change models, it is also possible for vulnerability mapping to be informed by bottom-up participatory approaches (AWC, 2009). The latter has the advantage of involving more realistic analyses and mapping more urgent threats to service provision as perceived by local stakeholders.

3.3.4 Using adaptive management

There is still a tendency for WASH planning procedures to be based on inflexible master plans that seek to implement “optimum” solutions. Often, planning procedures take little account of, for example, lessons learnt from monitoring and evaluation (M&E) activities on WASH delivery systems. Set in an environment in constant flux, the timely and appropriate response to WASH challenges is for WASH planning (and others aspects of governance) that take an adaptive approach that utilises lessons learnt from M&E activities. Adaptive management is based on the recognition that in a complex and rapidly changing environment, a fail-safe solution to challenges cannot be achieved. At best, developing a resilient WASH system may have the potential to provide a secure and acceptable level of service that is able to deliver across a wide range of climate, or other change scenarios.

A practical means of introducing principles of adaptive management in planning is through the adoption of a project cycle management (PCM) framework for stakeholder dialogue, decision making and change adaptation. The project cycle management framework emphasises the need to place decision making within a clearly defined set of iterative steps that ensure that the decisions reached are based on evidence and a clear and logical flow of thought. In addition, it ensures that decisions are based on a cycle of continuous adaptation or learning[3]. A prerequisite for this approach involves developing planning procedures that are supported by rigorous monitoring and information management systems, which allow for continuous adaptation and the upgrade of plans and activities.

3.3.5 Adopting and implementing "light" integrated water resource management (IWRM)

As it is probable that climate change will have both direct and indirect impacts on demand for and availability of water resources, it is likely that conflict between sectors will increase. In the 1990s, IWRM was proposed as an approach and framework within which this competition can be addressed. Whilst IWRM has been promoted enthusiastically for the last 15 years by the World Bank and others, the concept has attracted a lot of criticism for its vagueness and political naivety[4]. It is also notable that, for a variety of reasons, many large scale IWRM initiatives have failed to address and/or have a major impact on priority water management challenges (Shah and van Koppen, 2007; Shah, Makin and Sakthivadivel, 2005). Whilst much of the criticism is valid, it does not justify a return to or continuation of more technocratic approaches to sectoral governance that take little account of increasing competition for limited water resources. IWRM as a concept continues to inspire many adherents amongst international agencies and, like the equally elusive concept of sustainability, it holds inspirational value capable of stimulating the sector's creativity in searching for alternative and new ways to achieving improved water governance.

In contrast to the formulaic top-down approach to IWRM adopted by many IWRM programmes, "light" IWRM is opportunistic, adaptive and incremental in nature (Moriarty, Batchelor, Laban and Fahmy, 2010). Implementation of "light" IWRM is expected to result in an IWRM system that develops and evolves over time and, as a result, is better adapted or tailored to the changing political economy of a given area. It is also an approach to IWRM that is well suited to handling climate change and other sources of uncertainty.

[3] Moriarty, Batchelor, Laban and Fahmy (2007) show how this approach can be put into practice under conditions of water scarcity in the Middle East.

[4] For example, see Biswas (2004).

3.3.6 Improving the resilience of WASH systems

Improving resilience involves moving away from simply coping with impacts and managing risks to making informed investments towards facilitating long-term resilience (Burke and Kuylenstierna, 2009). This may involve developing practical measures that increase storage capacity (e.g. by constructing reservoirs or water storage tanks) or it could involve improvements in disaster preparedness. In the case of immediate “no or low regrets” expenditure, this can involve financial trade-offs between support for activities that improve resilience and support for activities aimed at improving the current level of WASH services of, say, the poor and the marginalised.

In any context, technologies capable of adapting to a range of risk and uncertainty scenarios need to be identified and prioritised (WHO/DFID, 2009). There must be recognition that some widely-used WASH technologies may not have the potential to improve resilience under some scenarios. In such circumstances, carefully-targeted communication and awareness raising programmes are needed, and are able to highlight the comparative benefits of these technologies.

Part Two
Practical approach for managing risk and uncertainty

4 Approach overview

4.1 Main components

The approach outlined here is based on the view that climate change should be treated as one of many sources of risk and uncertainty that have potential to impact on WASH services delivery. The approach itself is very simple (see Figure 1). It comprises of two components: project management and adaptation toolbox, and departs from the recognition that improved WASH governance is, in most cases, a prerequisite for the successful adoption and use of this approach.

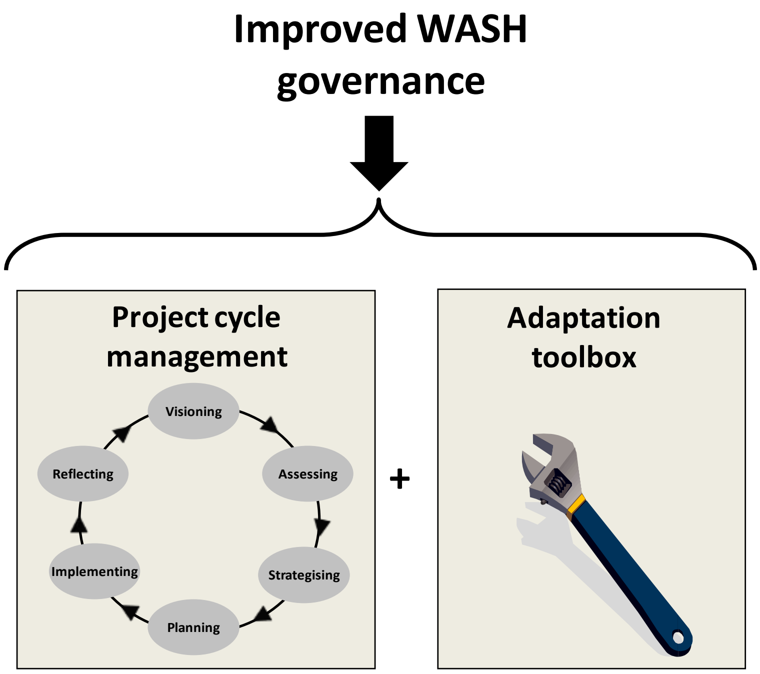

Figure 1 Main components of the approach to managing risk and uncertainty
Source: Own elaboration (2011).

Project cycle management. Project cycle management is proposed as the overall operational and adaptive framework for managing risk and uncertainty as it provides a proven, practical and logical basis for continuous adaptation and improvements in WASH services delivery.

Adaptation tool box. The methods, tools and frameworks in the adaptation tool box incorporate evidence-based methods, tools and analytical frameworks that can be used to mainstream the management of risk and uncertainty into WASH governance processes. Some of these are already being used by the WASH sector, whilst others are used more commonly in commerce, government, financial services and military sectors.

4.2 Project Cycle Management (PCM)

Project Cycle Management can be used to structure WASH governance processes in a clearly defined set of iterative steps, ensuring that decisions are based on a clear and logical flow of thought. Key attributes of the PCM include:

- It is problem and vision focused and, as such, it addresses identified problems within the context of achieving a clearly articulated vision that is shared by key stakeholders.
- It sees the creation of a commonly-owned and accepted body of qualitative and quantitative information as being essential to the development of coherent strategies and plans that have the ownership of these key stakeholders.
- It acknowledges that there will always be multiple paths to resolving problems and achieving visions. Or put another way, there is no objectively “best” or “optimum” strategy for achieving a vision.
- It provides a framework for continuous learning and adaptation so that each cycle of work learns from and builds on the accomplishments (or inadequacies) of earlier work.

While the exact sequence of steps in the project planning cycle is not critical, it is important that each step gives adequate attention to issues of risk and uncertainty. The version illustrated in Figure 1 is based on the planning cycle proposed by Moriarty, Batchelor, Laban and Fahmy (2007) as part of a set of water governance guidelines. It comprises the following phases:

Visioning. Initial problem identification, visioning and scenario[5] building. This phase can also include an awareness raising component to increase understanding of climate change issues, and an initial vulnerability assessment to determine whether existing or planned WASH delivery systems are particularly vulnerable to specific risks and uncertainties (including climate change).

Assessing. Targeted water accounting. This phase includes activities aimed at completing a rapid assessment of trends in WASH services levels and water supply and demand. It can also include assessment and prioritisation of different sources of risk and uncertainty and current levels of vulnerability (and/or resilience) of different WASH user groups.

Strategising. Development of strategies to achieve the vision under different scenarios that have been developed using the methodology described in Section 5.11 (Scenario Building). A key part of strategising is to identify and evaluate the risks associated with the strategies under each of the scenarios. It is also important that explicit consideration is given to the potential for building resilience, improving water security and identifying possible mal-adaptation strategies (i.e. strategies with significant negative externalities or trade-offs).

Planning. Detailed planning based on scenarios that are most likely to take place, while taking account of and preparing for highly unlikely scenarios with high impact. In terms of climate change adaptation, no or low regrets financing may also be allocated towards activities that aim at building resilience (e.g. improving governance capacity or social capital, increasing water storage etc).

Implementing. Execution of plans. In the context of climate change adaptation, implementation of plans can also incorporate specific local actions aimed at meeting risk and vulnerability mitigation goals (e.g. by taking community-based approaches and, where relevant, building local-level institutions).

Reflecting. Analysis of monitoring information and process documentation with the aim of making improvements to subsequent cycles of work.

The PCM framework can easily be expanded into an operational road map that details the main inputs, activities and outputs relating to each phase of the project cycle. Table 2 is an example of such a road map that includes a complete range of activities and inputs and not just those related to managing risk and uncertainty. It is important that the management of risk and uncertainty are mainstreamed into all phases of a road map, and not considered a one-off “tick box” activity. Although

[5] In this context of planning, a *scenario* is defined as a plausible and internally-consistent description of a possible future situation. This is somewhat different to the mathematical definition used by scientists and modellers who prefer to define a scenario in terms of a complete and coherent set of parameters and variables.

Table 2 suggests that a sequential process should be followed, the reality is that iterations are usually needed as, for example, new information becomes available or additional stakeholders become involved. It should also be recognised that the time taken to complete one cycle could range from a few days to a few years depending on the context and the scale of the work. However in all cases, the pace of progress should, as far as possible, be dictated by stakeholders rather than outside factors.

Table 2 An example of a PCM road map for improving WASH service delivery

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
Inputs & activities	Create a stakeholder platform and agree on domain(s) of interest. ↓ Awareness raising on climate change etc ↓ Problem and initial risk identification ↓ Develop a SMART vision	Water accounting ↓ Create a common information base ↓ Problem analysis & opportunity identification ↓ Awareness raising & information sharing	Narrative scenario building ↓ Strategy development taking account of scenarios Analysis to test whether strategy(ies) have potential to achieve vision If necessary, conflict resolution	Convert strategy into an implementable plan(s) ↓ Identify roles and responsibilities of stakeholders & other actors Produce life-cycle costings, work schedules, contracts etc	Implementation of plans ↓ Supervision and progress monitoring Stakeholder dialogue & resolution of disputes Awareness raising & information sharing	Post-implementation review and feedback to stakeholders ↓ Follow-up activities aimed at ensuring sustainability ↓ Transparency and value for money analysis ↓ Adaptation of strategies & plans to take account of lessons learnt
	Visioning	Assessing	Strategising	Planning	Implementing	Reflecting
Outputs	•Functional stakeholder platform •SMART vision for an agreed domain of interest	•Managed and shared information base •Agreement amongst stakeholders on the opportunities for tackling water-related problems along with the potential risks, constraints and uncertainties constraints	• An agreed set of narrative scenarios • If necessary, a revised SMART vision for the domain of interest • Agreement amongst stakeholders on a strategy or set of strategies that have potential to achieve the SMART vision	• Detailed work plans • A financial plan and approvals needed to commence implementation •If relevant, agreed contracts, HRD plans, M&E plans and any other outputs related to mobilisation of resources	•Completed work programme •Stakeholders who have taken ownership for relevant roles and responsibilities •M&E documentation	•Documented lessons regarding outcomes & processes followed •Set of transparency and value for money documents •Revised strategies and plans that will be used during the next project cycle

Source: Own elaboration (2011).

4.3 Adaptation toolbox overview

A wide variety of methods, tools and analytical frameworks can be used in conjunction with project cycle management. Some of these are directly related to managing risk and uncertainty (e.g. scenario building), while others are needed to establish the processes in which the management of risk and uncertainty should take place (e.g. facilitation of stakeholder platforms). Table 3 provides an inexhaustive list of methods, tools and analytical frameworks classified according to the phases in which they are most commonly used. It also details indicative activities that can take place under the different phases.

The majority of the methods, tools and frameworks in Table 3 are well-proven and/or are in regular use in the WASH sector. The next section of this report focuses on the methods, tools and frameworks that are not in regular use in the WASH sector but which are particularly relevant to managing risk and uncertainty (including climate change).

Table 3 Examples of methods, tools and analytical frameworks that can be used to manage risk and uncertainty[6]

Phase	Activities	Methods/Tools/Analytical Frameworks
Visioning	Awareness raising Agree roles and responsibilities Identify stakeholders Create stakeholder platform Initial problem identification Initial SMART visioning Initial vulnerability and risk assessment	Facilitation of stakeholder dialogue Problem trees Visioning tool ** Focus group discussion Key information interviews
Assessing	Awareness raising Identify information sources Information collection Quality control and triangulation Information management Information analysis and modelling Reconciling hard and soft information	Facilitation of stakeholder dialogue Water accounting ** RIDA framework ** CA uncertainty framework ** ICID/IWMI water use framework ** Statistical/time series analysis Bayesian network analysis ** Risk vulnerability and risk assessment ** Life-cycle costs assessment ** Qualitative information systems (QIS) **

(Table 3 continued on next page)

[6] Methods, tools and analytical frameworks marked with two asterisks (**) are discussed in the next section of this TOP.

Phase	Activities	Methods/Tools/Analytical Frameworks
Strategising	Awareness raising Scenario building Strategy evaluation Risk and uncertainty analysis Assessment of potential externalities	Facilitation of stakeholder dialogue Scenario building ** Strategy development ** Environment Impact assessment Conflict resolution tools
Planning	Awareness raising Develop detailed cost plan(s) Risk and critical path analysis Identification of M&E indicators Inter-sectoral planning alignment	Facilitation of stakeholder dialogue Various project planning tools (& software) Critical path analysis Human Resource Development (HRD) assessment
Implementing	Awareness raising Tendering HRD and institutional capacity building Quality control, progress monitoring etc M&E programme up and running	Various project management tools Various transparency tools Change management Stakeholder participation Institutional support mechanisms
Reflecting	Awareness raising Process Documentation Monitoring and reporting Value for Money (VFM) analysis	Process documentation VFM and transparency tools Various dissemination methods

Source: Own elaboration (2011).

5 Toolbox for identifying, prioritising and managing risk and uncertainty

5.1 Toolbox overview

The methods, tools and frameworks found in Box 2 are described in detail in this section. The common characteristics shared by these tools are:

- They are particularly relevant to identifying, prioritising and managing risk and uncertainty linked to climate change and many other factors;
- Although well proven, they are not in common use in the WASH sector.

Box 2 Tools for identifying, prioritising and managing risk and uncertainty

Visioning tool
Water accounting
Resources, Infrastructure, Demand and Access (RIDA) framework
Comprehensive Assessment (CA) uncertainty framework
ICID/IWMI water use framework
Bayesian network analysis
Vulnerability and risk assessment
Life-cycle cost assessment
Qualitative Information Systems (QIS)
Scenario building
Strategy development

The **visioning tool** can be used by a diverse group of stakeholders to reach consensus on a shared vision of WASH service levels they would like to achieve and sustain as part of a planning and wider governance process. This tool can also be used to agree on the scope of a planning process (or governance system) and whether or not there is sufficient support or buy in to the principle of mainstreaming the management of risk and uncertainty into the planning process.

Water accounting can be used to assess WASH service levels in space and time, and to assess trends in both water supply and demand. Water accounting can also be used to establish a shared responsibility for a quality-controlled information base that can serve as a basis for stakeholder dialogue and activities (i.e. vulnerability assessments or risk identification). Without such an information base, debate and decision making runs the risk of being ill-informed and/or based on guesswork, intuition or folklore. Furthermore, different stakeholders may have conflicting perceptions or understanding of, for example, the current status of WASH service levels.

The RIDA, CA and ICID/IWMI frameworks are often used as part of water accounting procedures. The **Resources, Infrastructure, Demand and Access (RIDA) framework** is used to structure water accounting, whilst the **Comprehensive Assessment (CA) uncertainty framework** is used to explicitly track levels of uncertainty in water accounting inputs and outputs. The **ICID/IWMI water use framework** is used to identify and quantify recoverable and non-recoverable water uses in a specified domain, as well as the potential impacts of different water uses on the hydrology of a specified domain.

Classical analysis of WASH delivery systems is based on verifiable certainties (e.g. volumes of water, numbers of latrines, etc). In contrast, **Bayesian network analysis** can be used to arrive at an analysis based on probabilities. In an increasingly uncertain world, Bayesian network analysis provides a practical tool for taking account of uncertainty.

Vulnerability and risk assessment of WASH delivery systems is used to identify potential "hot spots" or failure points across time and space and/or in relation to the different components of WASH delivery system. The nature of these "hot spots" or failure points can be technical (e.g. lack of storage), societal (e.g. weak institutions), financial (e.g. lack of expenditure on O&M) or linked to a wide range of other factors. Vulnerability assessments can also be used to identify components of delivery systems that have already exhibited a high-level of resilience to extreme events or incremental change. This often provides insights into how best to improve the resilience of the more vulnerable components

Life-cycle costs assessment, as the name suggests, is used to assess the disaggregated life-cycle costs of sustainable, efficient and equitable WASH service provision. A life-cycle costs assessment is used as a precursor to the allocation of "no or low regrets" expenditure for climate change adaptation by estimating the life-cycle costs of, for example, improving resilience in a specified area.

Qualitative Information Systems (QIS) can be used to capture the perceptions of water users on the status of WASH services, water governance systems and many other factors. QIS is based on ordinal scoring scales which convert qualitative information into numbers so that results can be analysed statistically and/or displayed easily on maps.

Scenario building is a key tool for identifying, prioritising and managing risk and uncertainty. It provides a basis for assessing the robustness of strategies to threats that although improbable, could impact greatly upon WASH delivery systems.

The innovative aspect of the **strategy development methodology** described in this section is that it mainstreams scenario building and visioning into planning and other governance processes. This is important because scenario planning is often used as an interesting but not particularly important accessory or add-on to planning processes.

5.2 Visioning

5.2.1 What is visioning?

The aim of a visioning process is to develop a consensus amongst a group of stakeholders and a commitment to work constructively towards the achievement of a shared vision. Visioning gives stakeholders an opportunity to discuss their concerns and fears with other stakeholders. Concerns can include risks and uncertainties such as climate change or any other factor that has the potential to impact on WASH services delivery. Typically, visioning comes at the beginning of a planning process. This is the time stakeholders should decide whether or not to mainstream consideration of risks, vulnerability and uncertainty into the planning process.

Visioning helps stakeholders to think beyond the day-to-day realities of problem solving and to imagine an achievable medium to long-term future for which they can plan - typically 5-15 years ahead at the community level, and 10-25 years ahead at the district or city level. To be useful as part of a wider planning process, a vision must be realistic and achievable, and grounded in the realities of trends in WASH services delivery and the successes (or failures) of on-going WASH projects or programmes.

Developing visions are invariably a political process. As a consequence, facilitation is needed to reconcile diverse and, at times, conflicting views on the relative importance of, for example, environmental sustainability, economic growth and provision of WASH services to the poor and the marginalised. This said, it is often easier to achieve consensus amongst a diverse group of stakeholders on the components of a vision than it is on the strategies and plans for achieving a shared vision. Or put another way, strategies and plans are often more politically contentious than visions.

5.2.2 Why is visioning important?

Experience has shown that visioning exercises help:

- Facilitate constructive discussion and understanding amongst a diverse group of stakeholders.
- Promote active involvement of stakeholders in developing and implementing WASH services delivery plans.
- Consider the boundaries of a planning process.
- Provide a target or benchmark against which the success or failure of strategies and plans can be monitored.

- Encourage stakeholders to look forward rather than to remain bogged down in current problems or disputes.
- Formulate a statement of intent that can attract the attention and enthusiastic support of the media.

5.2.3 Visioning: getting started

Generic activities that are needed to get visioning started include the following:

Facilitation. In most cases, visioning requires mediation. This includes setting up and facilitating stakeholder meetings and workshops, documenting the outcomes of these events, and circulating resulting materials to participants. Ideally, facilitators will have a good knowledge of the WASH sector and are trained and experienced in the use of facilitation techniques.

Specialist support. Is often needed to prepare materials for meetings and workshops. These materials can include reviews and copies of existing visions and time series analysis of trends that might need to be considered during the visioning process (e.g. increase in demand for WASH services over time by different user groups, changes in the vulnerability of delivery systems). Specialist support may also be necessary during some or all workshops to ensure that visions are realistic and achievable.

High-level support. Ideally, to gain credibility and legitimacy, a group of stakeholders, learning alliance or stakeholder platform members involved in visioning exercises should strive to partner with, or secure the support of, democratically-elected representatives.

Partnering with marginalised groups. Similar to above, the group of stakeholders, learning alliance or stakeholder platform should be gender aware and proactive in involving or representing marginalised social groups.

5.2.4 Visioning process

Generic steps that can be used for developing a shared vision are:

Step 1: Form learning alliances or stakeholder platforms if one does not exist as yet. Membership of a learning alliance or stakeholder platform is likely to change over time as new members join and as existing members lose interest. Hence, the role of the facilitator is crucial in proactively sustaining the interest and commitment of members.

Step 2: Agree on the scope of the vision over the area of interest and timeframe for which a vision is to be developed. In most cases, the area of interest is framed by institutional boundaries (e.g. a district or an urban area). The time frame will often be the same as the one(s) used by the district or urban authorities for other planning processes.

Step 3: Review existing visions is good practice to obtain copies of existing visions for the areas of interest that relate to the water and other sectors. Copies of visions relating to larger scales but encompassing the area of interest should also be obtained. Ideally, these visions should be reviewed and summaries should be made available to members of the learning alliance or stakeholder platform.

Step 4: Identify main issues that are to be included in the group's vision. Some of these will be directly related to the water sector (e.g. increasing water demand, climate change), while others may indirectly be linked (e.g. economic growth, energy costs). These issues can then be classified and prioritised using a combination of facilitation techniques that can include: problem tree analysis, brainstorming with the use of cards and/or a check list provided by the facilitators. Existing visions may also be used to stimulate discussions during this step.

Step 5: Develop an outline vision for the area of interest over the agreed timeframe. The vision is best described using a concise mixture of descriptive narrative and numerical targets. Techniques such as trend analysis, backcasting and forecasting can help to ensure that the visions take some account of current trends. Similarly, testing whether a vision is Specific, Measurable, Achievable, Realistic, and Time-bound (SMART) helps ensure that it more than a "wish list".

Step 6: Check for mutual consistency or alignment with other visions if relevant, check that the draft vision is consistent with visions at higher or lower spatial or administrative scales. A realistic vision statement must be aligned to the general trajectory of government policy. If there is no consistency on both counts, it may be necessary to make modifications in order to secure political support and increase the probability of funding for strategies and plans aimed at achieving the vision

Step 7: Assess the probability of achieving the vision if relevant, use the draft vision as a starting point for water accounting, scenario building and strategy development. The aim here is to assess the viability of different strategies and the risks and uncertainties relating to achieving the vision under different scenarios. If this analysis shows that there is a low probability of achieving the vision under some or all of the scenarios, the vision should be modified.

Step 8: Wider consultation processes, including the wide dissemination of information on a group's vision to interested parties at higher levels (e.g. national government officers, academics, relevant national NGOs). Elicit comments and feedback. Finalise the vision by taking account of constructive comments.

5.2.5 Visioning: lessons learnt

Practical lessons that have been learnt from visioning exercises and workshops include:

- In visioning workshops, allow plenty of time for discussion during both plenary and breakout sessions. There are also benefits in developing and adapting a vision iteratively over a series of meetings.
- It is advisable that facilitators who run visioning workshops already have relevant working experience in facilitation and developing visions themselves.
- Although scene-setting presentations can be very useful in prompting and guiding discussion, it is usually best not to include academic presentations in a visioning workshop.
- The involvement of specialists in visioning is crucial to facilitate the validity and robustness of the resulting vision. However, specialists should not be allowed to dominate meetings because ownership of the vision by the whole learning alliance or stakeholder platform could be compromised.
- Ideally, visions should describe a desired future state and, as such, the vision should not include a description of the strategies that will be used to achieve this desired future state.
- Including numerical information in visions increases their value if and when they are used to test whether strategies have achieved expected outcomes.
- Clearly and succinctly articulating a group's vision requires writing and data gathering/research skills. Writing style applied must be dynamic and engaging in order to support awareness building activities. Writing in different formats based on one's target audience is also very useful to strategically get messages across.
- Writing a clear, well-articulated and concise vision requires skill. Whilst care should be taken not to prejudice a vision, it is often helpful for those tasked with writing visions to have access to copies of existing well-written visions.
- Visions should be written in a lively and interesting style as this will increase their value in an awareness campaign.

5.3 Water accounting

5.3.1 What is water accounting?

Water accounting refers to a systematic study of WASH service levels and the current status and future trends in both WASH services provision and demand, with a particular focus on issues relating to accessibility, uncertainty and governance. Water accounting, also referred to as water resource assessments and water resource audits, is promoted as a key component of IWRM programmes. Water accounting can either take the form of a one-off activity designed to achieve a specific purpose, or it can be made part of a long term M&E programme aimed at improving and sustaining WASH services delivery. Information collected during water accounting is typically varied and addresses a range of societal, technical and governance issues.

5.3.2 Why is water accounting important?

Water accounting is a vital component of any planning procedure aimed at managing risk and uncertainty. It is used to assess and map out WASH service levels across time and space, and identifies the potential causes of imbalance between demand for, and access to, services. Water accounting details historical events linked to the performance of a services delivery system, as well as the sources of risk and uncertainty linked to its different system elements. Information drawn from water accounting also provides a solid basis for prioritising current or future sources of risk and uncertainty linked to and beyond climate change.

Information is a critical element for mediating and conferring power within societal relations or within stakeholder dialogue. Without information, debate is uninformed and stakeholders have no basis for challenging factually incorrect or biased positions. Effective planning is next to impossible if stakeholders are working with their own differing information bases. Yet such a situation is very common. For example, line departments, when attempting to align plans, rarely have access to a common information base. Similarly, local-level water users may have very different perceptions of their service levels compared to organisations responsible for providing the service. A key output of water accounting is, therefore, a common information base that is acceptable to all the primary stakeholders involved in a planning or other decision making process.

5.3.3 What are the main water accounting challenges?

Handling uncertainty. The dynamism in WASH service levels, societal responses to these service levels and variability in time and space pose major challenges to achieving sustainable, equitable and efficient WASH service delivery. Uncertainty is generally high, with availability of resources, the condition of infrastructure and users' demands changing continuously. Local populations are often responding to drivers of change that are far beyond the control of government departments or WASH professionals. As a result, service delivery plans need to be problem-focused (i.e. matched to the specific challenges in a specified domain) and dynamic in nature. Similarly, the procedures used in water accounting need to be adaptive and capable of changing as conditions and challenges change.

Differentiating between depleting and non-depleting water uses. As a key challenge in water accounting procedures, the ICID/IWMI water use framework (described in Section 5.6) can be used to classify different water uses and as a basis for mapping wastewaters (in time and space) that can be recovered and reused.

Updating information. Adaptive management is based on an acceptance that in complex situations there can never be sufficient information to come to an "optimum" decision (indeed the concept of optimisation becomes largely meaningless). It therefore puts the emphasis on flexible planning backed by strong monitoring and information management systems that allow constant adaptation and upgrading of plans and activities. Such a level of responsiveness is only possible if information bases are updated and based on monitoring and evaluation systems that continually provide decision-makers at all levels with reliable information on which they can (and do) base decisions.

5.3.4 What are the main types of water accounting

The nature and design of a water accounting procedure should be based on the context and need that is to be addressed. Experience shows that it is often best to carry out water accounting procedures in several phases of increasing complexity, with a first "back of an envelope" assessment guiding subsequent more detailed and focused cycles of information collection and analysis. There are three main categories that comprise water accounting. Light (or rapid) water accounting and comprehensive water accounting are, as their names imply, set against the two ends/extremity of a continuum. Problem-focused water accounting focuses on a specific issue or problem identified in the process of undertaking a light water accounting procedure. Table 4 (on the next page) summarises the key elements of the different categories of water accounting.

Table 4 Elements of the different categories of water accounting

Light (or rapid)	Problem-focused	Comprehensive
Initial identification of priority challenges, drivers, etc	Focused on an individual problem or set of problems. Usually follows light water accounting	Aimed at developing a comprehensive WASH-related information base that covers all WASH related issues within a specified domain
Initial assessment of easily available quality-controlled secondary data relating to physical aspects of resource availability and WASH services provision. Primary data collection is restricted to gap filling	Detailed assessment of quality controlled secondary data, with additional primary data collected where necessary	Comprehensive consolidation, quality control and assessment of secondary data related to physical aspects of resource availability and WASH services provision. Primary data to fill gaps and, in some cases, made part of a long-term M&E programme
Secondary data and rapid appraisal techniques for collecting societal information	Targeted rapid and participatory appraisal techniques for collecting information that is specific to problems	Participatory appraisal techniques for collecting societal information
Initial assessment of causes and drivers of problems	Detailed assessment of root causes and drivers of individual and/or combination of problems	Detailed assessment of root causes of problems, linkages between problems and externalities that influence demand for and access to WASH services

Source: Own elaboration (2011).

A distinction also needs to be drawn between one-off water accounting procedures that are designed to support a project or a programme, and water accounting procedures that are part of a long-term adaptive management programme aimed at sustaining certain levels of WASH services delivery. In the latter case, a first water accounting procedure may need to be comprehensive whereas subsequent water accounting on -- for example, an annual, bi-annual or continuous basis -- would be lighter in terms of resource requirements. Subsequent water accounting procedure will primarily focus on updating information and analysis.

5.3.5 *Water accounting: getting started*

Although the exact objectives of water accounting procedures can vary enormously, water accounting provides an opportunity for stakeholders to reach a shared understanding of the causes of WASH services delivery problems. Ideally, the main responsibility for undertaking water accounting should rest with the collective membership of multi-stakeholder platform. However, it is likely that the relevant work will be led by one or more of the stakeholder organisations or contracted out to an organisation with the appropriate skills and capacity. Whoever leads the process, it is highly desirable that all stakeholders participate actively in all aspects of water accounting.

Generic activities that are needed to get water accounting started include the following:

Specify the domain[7]. Specify initial spatial and temporal boundaries for information collection. The spatial boundaries can be physical or institutional, for example village boundaries, watersheds or aquifers. The temporal boundaries are time limits (past and future) for considering key trends. The focus may be primarily at one particular level (e.g. intermediate), but it is important to collect sufficient information at higher and lower levels to be able to make judgements regarding, for example, externalities or inadequate service delivery to poor and marginal social groups.

Specify objective(s) of the water accounting. Specific objectives can be agreed as part of a visioning exercise or as part of an initial light water accounting procedure. Once defined, the objectives help determine the information that should be collected, the analysis that may be needed and the outputs that are required.

Agree on the type of water accounting that is needed. The choice is between light water accounting, problem-focused water accounting, comprehensive water accounting or some variation of all three.

Specify information needed. Information consolidation should be based on a needs assessment. Specify details regarding the information required, such as the required degree of disaggregation, the scale of maps, the level of granularity and the levels of precision.

Identify sources of information. Identify easily available secondary sources of information (e.g. existing information collected by line departments or as part of earlier projects or programmes), and decide what primary information (i.e. new

[7] A specified domain for water accounting defines the area of interest bounded in time and space. The specified domain should also define the institutional and other societal boundaries that will be relevant to the WASH delivery system. In some cases, it may also define the users or user groups that will be the focus of the water accounting.

information) may be needed to fill gaps, to quality control existing information and to bring existing information up-to-date.

Form a multi-disciplinary team to do the work. In most cases, skills will be needed to analyse both the demand and supply sides of WASH delivery systems. A high-level competency and experience in information management are also highly desirable (e.g. GIS and data-basing skills). Decide also on the level of specialist support (if any) and analytical tools that may be needed.

5.3.6 Water accounting process

Once the "getting started" activities have been completed, it is possible to move on to the main water accounting process. Although there is no set formula or iterative sequence for a water accounting process, in generic terms there are five main phases:

Phase 1: Awareness raising is vital if stakeholders are to become fully involved. Particular attention has to be paid to ensuring that the poor and other marginalised groups are aware of what is happening, are able to participate, and/or are sufficiently represented in meetings.

Phase 2: User group analysis and institutional mapping is critical to ensuring that water accounting takes cognisance of competing users and uses of water, and the roles and responsibilities of different institutions at different levels. Essentially this phase revolves around building a good understanding of different categories of WASH services users, and their rights and responsibilities. Who has access and who maintains control over water supply or sanitation infrastructure? What divisions exist in society related to wealth, gender, ethnicity or other reasons?

Phase 3: Gathering information and quality control involves identifying and accessing existing (secondary) sources of information, quality controlling information and consolidating it into an information base using the RIDA or another framework. Where necessary, additional primary data will also need to be collected and quality controlled, especially for access and demand related issues. Triangulation of data from different sources and levels is often a good means of ensuring internal consistency.

Phase 4: Data analysis aims to investigate the causes of WASH-related problems and to identify possible solutions. This can involve a range of analytical and statistical techniques including time series, water balance analysis or mapping of WASH services levels. This phase requires the development of information systems, using spread sheets and GIS, and in more complex cases, databases and modelling.

Phase 5: Dissemination of information to key stakeholders in a format that is likely to support and improve stakeholder understanding and dialogue.

5.3.7 *Water accounting: lessons learnt?*

Practical lessons that have been learnt from using water accounting include:

- Quality controlling of secondary information using filtering, triangulation and other techniques, is a crucial step in water accounting that often takes a lot of time and perseverance.
- Water accounting is easy for people with enquiring minds who also have an interest in multi-disciplinary analysis. It is not so easy for people who prefer to work within the limits of their respective areas of specialisation.
- Involvement of primary stakeholders in quality control, analysis and interpretation is almost always beneficial.
- Specialists (e.g. hydrologists, geologists, economists, social development specialists, etc.) play a vital role in accounting procedures.
- Summary outputs from water accounting should be produced in forms or formats that non-specialists can understand.
- Findings and, if relevant, recommendations should be developed iteratively with the participation of stakeholders (at all levels).
- In quality controlling, analysing and information dissemination activities, it is critical that weight is given to both hard (technical) and soft (societal and perception based) information. There is a tendency to give more attention to technical information, as it is more easily quantifiable and easier to analyse. However, techniques and tools such as Qualitative Information Systems (QIS) can and should be used to elicit soft information that can be subjected to statistical analysis.
- The knowledge of local-level stakeholders should not be under or over-estimated. Village-level stakeholders can provide real insights into the nature and severity of change processes in and around their villages. However, local-level stakeholders tend to be less reliable when it comes to identifying the causes of these changes.

5.4 Resources, Infrastructure, Demand and Access (RIDA) framework

5.4.1 What is a RIDA framework?

The RIDA framework is based on the understanding that water resources are linked to users by supply (and water treatment) infrastructure, and that each of these three system elements (resources, infrastructure, users) has its own set of institutions, boundaries and characteristics. In other words, there are three systems elements that need to be considered when describing or analysing WASH services delivery systems.

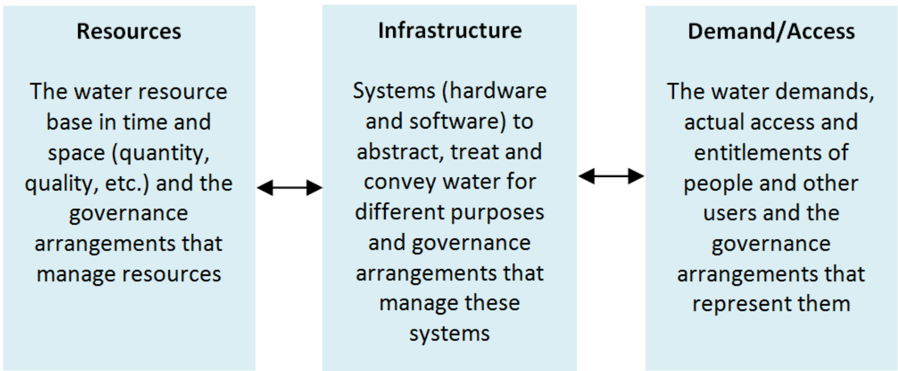

Figure 2 The RIDA Framework

Source: Own elaboration (2011).

At any level of complexity, it is only possible to solve WASH delivery problems once the root causes have been identified systematically. The RIDA framework can be used to structure analysis and discussions relating to complex delivery systems that have, for example, multiple sources, multiple competing demands and complicated infrastructural systems that have been developed over a long period of time. The RIDA framework can also be used to structure analysis of relatively simple water delivery systems for a small community by highlighting the fundamental causes of water supply problems. For example, the root causes of these problems could be infrastructural (e.g. a pump breakdown), societal (e.g. social exclusion from using certain water points) or resource-related (e.g. falling groundwater levels and/or deteriorating water quality).

In the context of integrated water resources management, the RIDA framework can be used, for example, by a learning alliance to structure the analysis of complex governance systems and map the level of participation of stakeholders in different aspects of the governance system. The RIDA framework can also help structure analysis that reveals the levels of legal entitlement that users have over access to water for different uses, under a range of conditions that vary in space and time. Similarly, the RIDA framework can be used to structure life-cycle costs assessments (see Section 5.9).

5.4.2 RIDA framework: getting started

As might be expected, the materials and resources needed for developing and using a RIDA framework will depend on the scale and level of complexity of a specific delivery system. This said, the following will be required in most cases:

- A specialist or a group of specialists with a good understanding of technical and societal aspects of the WASH delivery system(s).
- Experienced facilitators who understand the WASH sector and have previous experience in facilitating stakeholder dialogue at different levels.
- Specialists with good information management, data analysis and, possibly, modelling skills.
- Access to good quality information. In most cases, this will require the support and interest of senior professionals in relevant government line departments and/or water utilities.
- Sufficient time and resources to work interactively with relevant stakeholders and/or a learning alliance.

5.4.3 RIDA framework: generic methodological steps

The following are a set of generic steps that can be used to develop and use a RIDA framework. Although presented as a stepwise process, in practice it is often necessary to repeat steps iteratively.

Step 1: Discuss and agree upon objective(s). Discuss and reach agreement on the objective(s) of developing and using a RIDA framework. Clearly, there is no point in using a RIDA framework unless there is agreement that it will improve, or at least contribute to, effective planning or improved WASH governance processes.

Step 2: Discuss and agree upon the area(s), domain(s) and scale(s) of interest. As a continuation of Step 1, discuss and agree upon the extent and boundaries of the area(s), domain(s) and scale(s) of interest to be covered by the RIDA framework and subsequent analysis. This discussion should include consideration of whether analysis of historical trends is required and, if so, over what time period. This discussion should also include consideration of the societal and technical scale(s) of interest. For example, societal scales of interest could be one or all of the following: household, community, urban district and/or city. On the other hand, technical scales of interest may refer to the extent of a drainage or piped water supply network.

Step 3: Identify the available resources. As a continuation of Steps 1 and 2, identify the resources that are available for developing and using a RIDA framework. This will also determine the time available for analysis and/or discussions, the financial and human resources that can be used, the potential level of stakeholder participation and whether or not capacity building is required and/or is feasible.

Step 4: Identify information that is required. Determine the information that is needed to achieve the objective(s) identified in Step 1. A check list of questions that might need to be answered is provided in Box 3. This list can be modified according to objectives of specific discussions or analysis and/or whether sanitation or water services are the priority interest.

Box 3 Example of a list of questions structured using a RIDA framework

Resources
What water resources are drawn on by the water supply infrastructure?
What is the sustainable quantity of acceptable quality water that they can supply?
What other demands are made upon them?
What major institutions are involved in managing water resources? What are their roles and responsibilities?

Infrastructure
What are the main physical elements for the water supply infrastructure (reservoirs, canals, treatment plants, pipe networks etc)?
What is the capacity of this infrastructure (storage, treatment, supply) to meet demand?
What institutions are related to water supply infrastructure?

Demand and Access
What is the demand for water from different water-users and societal groups (quantity, quality, reliability, location)?
What existing access do users have to water now; to what extent is demand satisfied?
What are the key water related institutions relevant to the various water-user groups?
What barriers to access are experienced by different water-user groups (high user fees, requirement to have membership of associations etc)?

Source: Own elaboration (2011).

Step 5: Identify sources of information. A brainstorming session with knowledgeable specialists is usually a good starting point for identifying sources of existing information. At the same time, it is usually possible to obtain expert opinion on the quality of existing information and whether or not primary data collection will also be required.

Step 6: Create and quality control an information base. Information collected should be quality controlled and stored in an information base. Ideally, the storage structure should reflect the RIDA components, for example, by using different worksheets within a spread sheet to summarise each RIDA component.

Step 7: RIDA analysis. RIDA analysis can be an integral part of water accounting and involve activities such as institutional and decision mapping, water balance analysis and modelling.

Step 8: Disseminate outputs. Although the analysis and modelling may be sophisticated, the resulting outputs should be in a form that can be understood easily by potential users of the information.

5.4.4 RIDA framework: challenges and tensions

A well-worked RIDA framework helps bring order to apparent complexity and, in so doing, structures stakeholder dialogue and specialist analysis or modelling. However, a number of challenges and tensions often crop up. These include the following:

Fuzzy boundaries. The societal and technical boundaries between the three components of a RIDA framework (i.e. between Resources, Infrastructure, Demand and Access) can be quite fuzzy. For example, in a heavily-engineered river basin, almost all surface and ground water resources are related to infrastructure. In such cases, a decision has to be made on whether the river system should be regarded as a resource or a component of an infrastructural system. Similarly, the boundaries between components of a governance system are often indistinct and judgements often have to be made.

Quality and availability of information. It is always easier to produce a schematic diagram of a water delivery system in RIDA format than it is to populate this diagram with quality information. The quality of information is often varied. Although some information may be acceptable in terms of its quality, other information may be out of date or incorrect. The key is to ensure that sufficient time and other resources are allocated to quality controlling and ground-truthing information. The accessibility of information can also pose a major challenge. Data is often fragmented in that it is held by different organisations and, in some cases, by different departments or individuals within these organisations. Restrictions may also exist on the sharing of information particularly if regarded as being sensitive (e.g. costs of constructing WASH infrastructure).

Spatial and temporal scales. The spatial and temporal scales at which data has been collected by different organisations are often far from consistent. This can necessitate disaggregating or aggregating information linked to different components of a water delivery system. This takes time and, in many cases, results in a reduction in confidence in the information.

Level of detail. There is a tendency, particularly in interdisciplinary teams, for specialists to want to collect information in more detail than is really necessary. Collecting and processing information is costly, and should therefore always be clearly linked to actual decisions and problems within a paradigm of optimal ignorance and appropriate imprecision.

Range of formats. Information is usually retained in a wide range of different formats (e.g. text, tables, figures, maps, remotely-sensed images, etc) and media (e.g. reports, hard disks, the internet, journals, etc). It is easy to underestimate the time needed to reconcile information that has been stored in different formats using different media.

5.4.5 RIDA framework: lessons learnt

Practical lessons learnt from using the RIDA framework include:

- The boundaries between elements of RIDA are not always clear. Defining RIDA components is something that is best done in a local context as part of a stakeholder dialogue process.
- It is usually more useful and efficient in terms of resources to collect and reconcile information that relates specifically to the interfaces of the RIDA framework (see Table 5), as opposed to collecting information haphazardly across the whole delivery system.

Table 5 RIDA interfaces

RIDA interfaces	Focus of RIDA analysis
Resources - Infrastructure	**Extraction estimates:** Volume and quality of water in space and time entering into water supply infrastructure. Volume and quality of return flows to rivers or groundwater
Infrastructure - Demand	**Delivery estimates:** Volume and quality of water delivered at the point of supply to different users in space and time. A measure of unaccounted for water can be based on differences

(Table 5 continued on next page)

RIDA interfaces	Focus of RIDA analysis
	between extraction and delivery estimates
Demand - Access	**Water poverty estimates:** The extent to which delivery of water meets the demands of users (including the environment) in space and time

Source: Own elaboration (2011).

5.5 Comprehensive Assessment (CA) uncertainty framework

5.5.1 What is the CA uncertainty framework?

Figure 3 presents a slightly modified version of the uncertainty framework that appears in the Comprehensive Assessment of Water Management in Agriculture (2007). The CA uncertainty framework is based on the assumption that uncertainty in planning and governance processes is linked primarily to the following:

Amount of evidence. All verifiable information relating to the status of WASH services delivery systems and the service levels that they provide.

Level of agreement. The level of agreement reached amongst stakeholders on the reliability and authenticity of specific information taking account of, for example, disputes between users and providers of WASH services, line departments, states or countries (e.g. in the case of trans-boundary waters) and between political parties. This type of uncertainty also recognises that there is often a low level of agreement on the relevance and importance of climate change and other sources of risk and uncertainty.

Figure 3 **Uncertainty framework**
Source: Comprehensive Assessment of Water Management in Agriculture (2007).

5.5.2 What are typical sources of uncertainty in a water accounting process?

The availability of water related information varies enormously from region to region and country to country. Even in countries that have a wealth of information, data on even the most basic technical and societal realities are often difficult to access or utilise for water accounting processes. The reasons for this are numerous, but typically include:

- Information is out of date or has been lost or poorly archived.
- Quality of data is poor because no quality control or triangulation procedures have been used during data collection or processing.
- Data is fragmented in that it is held by different organisations and, in some cases, by different departments or individuals within these organisations.
- Restrictions are placed on access to information for political, commercial, military or other reasons.
- Potential users have access to the data, but it is in a form that is incomprehensible, or the time needed to convert the data into a usable form is prohibitive.
- Potential users do not trust available information even when it is of good quality. In such cases, users may be inclined to put more faith in guesswork, intuition or folklore.

5.5.3 Using the CA uncertainty framework

The CA uncertainty framework can be used to ensure that water accounting processes recognise that, in any given context, there will be multiple sources of uncertainty that will vary across time, space and institutional levels. The CA uncertainty framework can be used in tracking and labelling uncertainty during water accounting processes. It is particularly important that stakeholders and other users of hard or soft information have access to concise feedback on uncertainties in this information and whether or not the information is contested.

In any water accounting process, procedures should be adopted to minimise levels of uncertainty within the constraints that exist (e.g. time and resources available). Trade-offs inevitably arise between taking time to acquire information with a low level of uncertainty and providing information to decision makers when they need it.

5.6 ICID/IWMI water use framework

5.6.1 *What is the ICID/IWMI water use framework?*

Table 6 presents a version of the ICID/IWMI water use framework that is an amalgam of frameworks described by the ICID (Perry, 2007) and IWMI (Molden, 1997). For a specified domain, this framework is used to classify withdrawals of water into: 1) **different use classifications** that reflect whether a specific water use is depleting or non-depleting; a depleting water use is beneficial or not; and, a non-depleting water use is recoverable or not; and 2) **different uses** that reflect anthropogenic impacts on the hydrological cycle.

Table 6 ICID/IWMI water use framework

Depleting water use	**Beneficial**	e.g. evaporation from irrigated or rainfed crops (but not from the soil surface), evaporation from a cooling tower
	Non-beneficial	e.g. evaporation from lakes, reservoirs or irrigation channels, evaporation from the soil surface of cropped land
Non-depleting water use	**Recoverable**	e.g. ecological flows in rivers that are not lost to sinks, drainage to groundwater, treated sewage, return flows from irrigated areas, navigation, water sports
	Non-recoverable	e.g. water flowing to the sea, water polluted to the point that cannot be treated at an economic cost
Change in water storage	**Negative**	e.g. change in reservoir storage, change in groundwater levels, change soil moisture deficit
	Positive	

Source: Own elaboration (2011).

Definitions of terms relevant to Table 6:

- **Specified domain:** The area of interest where accounting is to be carried out, bounded in time and space.
- **Withdrawal:** Water abstracted from streams, groundwater or storage for any purpose (e.g. irrigation, industrial, domestic, commercial, environmental uses).
- **Water use:** Any deliberate application or utilisation of water for a specific purpose. The term does not distinguish between uses that remove the water from further use (e.g. irrigated and rain-fed agriculture) and uses that have little quantitative impact on water availability (e.g. navigation, hydropower, most domestic uses, maintaining ecological flows).
- **Available water:** The volume of water available to a service or use, which is equal to the inflow less the committed water. Committed water includes water needed to maintain aquatic eco-systems.
- **Depleting water use**: A water use or removal of water from a specified domain that renders it unavailable for further use within the specified domain.

5.6.2 *Why is the ICID/IWMI water use framework important?*

The application of the ICID/IWMI water use framework is crucially important to effective and accurate water accounting because it reduces the risks of double accounting during water balance analysis. The framework also provides an elegant means of assessing and mapping the potential for recycling water in time and space.

When used as part of water accounting and a planning process, the ICID/IWMI water use framework also reduces the risk of unfavourable decision making. Rarely are clear distinctions made between the withdrawal of water and whether or not a water use is depleting (Perry, 2007). For example, in the case of a typical house connected to a main sewer system, some 95% of the water delivered by the water utility is returned for treatment and subsequent reuse. Regardless of this fact, wild claims are often made in respected journals that vast quantities of water can be ''saved'' by increasing ''efficiency'' through the use of low-flow showers and mini-flush toilets. Contrary to this, the fact remains that the consumptive use of a shower bath or toilet is nearly zero if they are connected to a sewer. Just as importantly, it is invariably the hydrological location of the diversion and return flows that determines the impact of shower or toilet designs on total water use and consumption.

5.6.3 *Using the ICID/IWMI water use framework*

The ICID/IWMI water use framework may be used:

- Alongside the RIDA framework in water accounting, particularly when making water balance calculations.
- When examining components of different strategies in response to different scenarios, with the aim of assessing and mapping the potential impacts and externalities that may be linked to the former (e.g. potential downstream impacts of land use change linked to climate change mitigation).
- When assessing the potential for developing unconventional water resources (e.g. wastewater treatment, localised water harvesting).
- To raise awareness of the adverse impacts of many large programmes that have been based on the erroneous use of water efficiency concepts.

5.7 Bayesian network analysis

5.7.1 *Why is Bayesian network analysis useful?*

Bayesian Networks have two major functions. Firstly, they can be used to investigate relationships between variables in a system and, secondly, they can offer insight into (future) behaviour patterns of a specific system as a whole, or in relation to individual variables that are part of the system. If a Bayesian Network is to be used to make predictions, it provides a representation of the process or a system framed within acceptable levels of uncertainty. Similar to other modelling systems, Bayesian Networks simplify systems and/or processes that in some cases are considered inadequate in producing scientifically "objective" results.

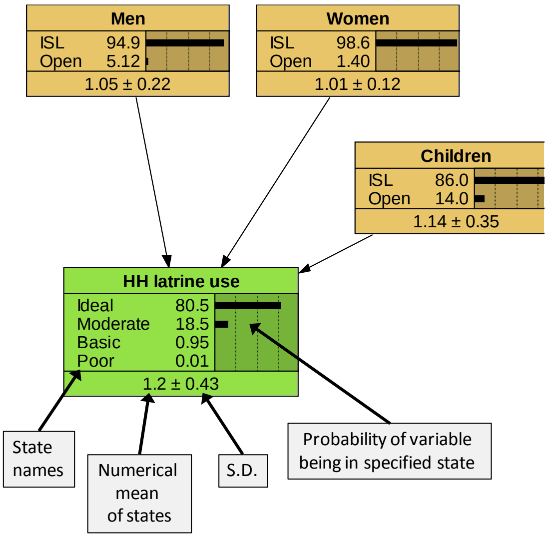

Figure 4 **An example of a simple Bayesian Network for analysing latrine use**

5.7.2 *What is Bayesian network analysis?*

In essence, a Bayesian Network is a decision analysis framework, based on Bayesian probability theory, which allows the integration of scientific knowledge (i.e. hard data) and expert opinion (e.g. soft data), and the uncertainty associated with this data. The approach involves describing a system in terms of variables and linkages, or relationships between variables, at a level appropriate to decision making. This is achieved through representing linkages as conditional probability tables, and propagating probabilities through the network to give the likelihood of variable outcomes. Therefore, the approach ensures that treatment of risks and uncertainties is an intrinsic part of the decision making process. The Bayesian Network is dynamic and interactive, and hence if a network previously developed does not fit a user's conceptual understanding of the system, it can be adapted quickly and simply to the cognitive understanding of the user.

5.7.3 *Bayesian network analysis: getting started*

Getting started with Bayesian Networks is relatively easy because the software is relatively easy to use, and it is available commercially. Online tutorials are also available[8]. These will be sufficient for anyone to get started as long as they have some modelling experience.

5.7.4 Bayesian network analysis process

The following are a set of generic steps that can be used to develop and use Bayesian Network analysis. Although presented as a linear process, in practice it is often necessary to repeat some steps iteratively.

Step 1: Needs assessment. The starting point is a needs assessment regarding the purpose and/or specific needs for outputs, and a review of existing modelling and/or data analysis procedures that might already be in use by stakeholders.

Step 2: Model specification. Using the findings of the needs assessment , a model network specification is drawn up that details the process or system to be modelled, the spatial scale and time domain over which the network is to function, the main input and output variables and relationships, and the required levels of accuracy or precision.

Step 3: Knowledge assessment. It is sensible to assess the current state of knowledge and understanding of the system or process. In most cases, it is possible to learn from previous attempts to model the system or process. Comparative analyses of the utility of different modelling systems can also be used to underpin decisions on the network design.

Step 4: Availability of information. Assess whether model input information identified in Steps 1-3 is readily available or can be collected within an acceptable timescale and cost.

Step 5: Develop, test and validate a prototype[9] network. As there is a risk for modelling to take longer than expected and/or to fail to generate useful outputs, it is sensible to produce and to test a prototype network. The prototype network may be validated by comparing model predictions with information that has been obtained independently. Independently obtained information may take the form of statistics/numbers or observations/expert opinion of key stakeholders.

Step 6: Convert the prototype into a useable network. Once the prototype is working acceptably well, it should be upgraded to meet all the specifications agreed in Step 2. It is often best to upgrade in a series of iterations rather than in one step. It

[8] An on-line tutorial on the use Bayesian Networks and commercially-available software can be found on: http://www.norsys.com/.

[9] A prototype is a functioning network that does not yet meet all specified requirements or achieve desired levels of user friendliness.

may be necessary to revalidate the network after each iteration or at the end of this process. Users may need training in how to use the network.

Step 7: Predictions and simulations. Use the model to produce predictions and simulations that may support visioning exercises, scenario building or strategising.

5.7.5 Bayesian network analysis: lessons learnt

Generic lessons learnt from using Bayesian Network analysis include:

- Although getting started with and using Bayesian Network analysis is relatively easy, it takes time and aptitude for anyone to become skilled in the development of networks.
- Bayesian Networks are often used by projects as a gimmick or attention-grabber without being mainstreamed into planning or governance processes.
- The key to effective network building and the use of models is to ensure that the modelling fits a clearly defined purpose, producing outputs that support specific needs (e.g. resolving disagreements amongst stakeholders on the relative merits of different strategies).
- If networks are being developed by people who are not going to be the long-term users, the developers must work very closely with the users. In addition to providing hands-on capacity building this ensures that the model fits the requirements of the users.
- It is often necessary to repeat steps 1-4 several times before a viable and easy-to-use network is developed.
- It is recommended that users always maintain a healthy scepticism on the network's outputs. Bayesian networks are useful to support decision making processes, but should not be used as a means for making decisions.

5.8 Vulnerability and risk assessment

5.8.1 What is a vulnerability and risk assessment?

In the context of WASH delivery systems, a vulnerability and risk assessment is a systematic identification in time and space of WASH system components that are most vulnerable to extreme events or incremental change and, as a consequence, are most likely to underperform or even fail catastrophically. In the case of water delivery systems, components include the technical components of the system (e.g. from source to tap), the institutions responsible for managing systems, the rights and entitlements of users, public finance mechanisms, and so on. In the case of sanitation, components include the sanitation infrastructure, systems of solid waste disposal and institutions responsible for environmental sanitation.

5.8.2 Why are vulnerability and risk assessments important?

Anticipating and mapping potential vulnerability and risks (including climate change) while designing resilience into WASH delivery systems can lead to more robust projects and programmes that serve their target populations better (USAID, 2007). Conversely, the failure to do so increases the likelihood that there will be slippage in service levels, and/or delivery systems will become obsolete prematurely.

5.8.3 Vulnerability and risk assessment: getting started

Water accounting. Is the ideal starting point for an effective vulnerability and risk assessment. Water accounting is useful in analysing and mapping the current performance or functionality of technical, institutional, legal and socio-economic components of delivery systems. Particular attention should also be given to identifying the historical causes of component failures or under-performance.

Facilitation. The approach to vulnerability and risk assessment described here requires active stakeholder involvement. This will benefit from the support of a facilitator or a facilitation team over a period of many months. Ideally, facilitators will have a good knowledge of vulnerability and risk assessment.

Carefully-targeted awareness raising. Is needed to ensure that there is capacity to respond to future risks or threats that may well be outside the experience of stakeholders.

Specialist interdisciplinary support. Is usually needed to prepare materials for risk and vulnerability assessment meetings and workshops. These materials should include rigorous assessments of potential risks and threats along with options for mitigation and/or adaptation.

Scheduling vulnerability and risk assessment. Although vulnerability and risk assessment exercises can be scheduled as a separate activity, there are advantages in undertaking an initial vulnerability and risk assessment as part of the visioning phase of a planning cycle. This can be followed by a more detailed vulnerability and risk assessment exercise that forms an integral part of an iteration process of developing and evaluating strategies and plans.

5.8.4 Vulnerability and risk assessment process

The following are a set of generic steps that can be used to develop an overall risk and vulnerability assessment (CSES, et al., 2007). The exact sequence of steps, number of iterations and the time that might be needed to complete the process will depend on the context.

Step 1: Initial vulnerability screening provides a preliminary assessment of the scope of vulnerability of a WASH service delivery system to a wide range of risks and changes (including climate change). Factors such as functional integrity, effectiveness and/or longevity of the delivery systems are investigated. In most cases, the historical causes of system breakdown and failure points are also examined.

Step 2: Detailed identification of risks factors can take place as part of scenario building (see Section 5.11). The aim of this step is to classify potential risks according to immediacy (i.e. short, intermediate and long-term), likelihood and potential impact. The resulting list can include factors well known to stakeholders, those experienced by WASH service providers or users in other areas, and risk factors identified or predicted by specialists. Risk prioritisation or ranking should be based on how each risk is viewed (risk perception) and accepted (risk tolerance), with the proviso that risk perception and tolerance can vary widely over time and with personal experience.

Step 3: Sensitivity assessment evaluates the degree to which a WASH delivery system (and/or its components) is likely to be directly or indirectly affected by extreme events or incremental change (including climate change). A system that is likely to be affected by change is automatically categorised as sensitive to change. Questions that may support sensitivity assessment processes include:

- What is the level of exposure of the system to the impacts of climate or other change? For example, is the system located in an area prone to flooding?
- What is the condition of the system? Is it a system that is already failing to meet current expectations and therefore is more sensitive to extreme events or incremental change?
- Will climate change lead to an increased demand for services therefore exceeding supply specifications? Or is it likely that another "impact threshold" will be exceeded (e.g. flood-defence systems overtopped, water treatment plants inundated)?

Step 4: Adaptive capacity (or vulnerability) assessment describes the ability of a WASH delivery system to accommodate changes with minimum disruption to service levels or changes to the costs of service provision. As a general rule, systems or components of a system that have a high adaptive capacity have a better resilience and the capacity to deal with climate change. Some questions that support this type of assessment include:

- Is the system capable of accommodating extreme climatic events and other shocks?

- Are there barriers to or constraints on a system's ability to accommodate changes in climate and other factors (e.g. legal barriers, public finance barriers, etc)?

Step 5: Risk assessment and mapping in time and space. Risk is a function of the probability of a change occurring and the potential severity of the impact of these changes on the service levels provided by a WASH delivery system. Findings of risk assessments, when analysed together with findings of an adaptive capacity assessment, can be used to produce scenarios that give an indication of the range and scale of change impacts in time and space. It should be noted that risk assessments require constant revision as new information on climate change and climate impacts become available. Non-climatic factors like population growth will also place additional demands on WASH services provision, compounding the risk associated with climate change impacts. Climate change itself may shift the consequence, probability and magnitude (and therefore risk) of any particular event. Similarly, preparedness planning itself may reduce risk associated with specific change impacts.

Step 6: Identification of "hot spots" or potential failure points. A simple vulnerability matrix can be used when mapping hot spots or potential failure points in a WASH delivery system (see Table 7).

Table 7 Example of a vulnerability-risk matrix

	Low vulnerability	High vulnerability
High Risk	Moderate priority	High priority
Low risk	Low priority	Moderate priority

Source: CSES, et al. (2007).

5.9 Life-cycle costs assessment

5.9.1 *What are WASH life-cycle costs?*

WASH life-cycle costs represent the aggregate costs of ensuring the sustainable[10] and equitable delivery of a certain level of WASH services to the population of a specified area. Life-cycle costs cover the unit costs of construction and maintenance of a WASH delivery system along with all other unit costs that are often overlooked or ignored when budgets and financing are discussed and finalised (e.g. costs relating to institutional development, capacity building, source protection, pro-poor planning and capital maintenance).

5.9.2 *Why should the life-cycle costs be considered when planning and managing WASH delivery systems?*

A good understanding of life-cycle costs is fundamental to:

Improving the design and management of WASH delivery systems. Despite huge investments in the WASH sector, WASH service levels remain stubbornly low in many parts of the world. This indicates that this challenge will not be solved by solely increasing overall expenditure. Clearly, outcomes and value for money will only be achieved if all the components of a WASH delivery system are financed adequately.

Tackling WASH slippage. Service levels provided by WASH delivery systems tend to slip back over a period of time especially when, as is often the case, expenditure is heavily skewed towards construction and technical aspects of service provision.

Improving the resilience of WASH delivery systems to shocks and extreme events. WASH delivery systems that are financed on the basis of life-cycle costs tend to be more resilient and therefore more able to adapt to challenges thrown up by climate change and other uncertain events. One reason being that adequate finance for participatory planning and institutional development ensures that systems are more likely to be properly managed and maintained.

Ensuring that the poor have equitable access to WASH services. Experience has shown that concrete actions need to be taken if the poor, particularly poor women, are to participate actively in the planning and management of WASH delivery systems. Similarly, decisions on tariffs or connection charges must take full account of the needs and constraints of the poor, as well as the risk that the benefits of a delivery system will be captured by elites, to the detriment of the poor.

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[10] In this context, a wide definition of "sustainable" is used to include environmental, institutional, social and financial sustainability.

Adapting to climate change. "No or low regrets" expenditure is seen by many as an important plank of climate change adaptation strategies. This makes sense especially if "no or low regrets" expenditure is based on life-cycle costs assessments and the focus of resulting activities is on improving the overall resilience of WASH delivery systems and not solely on construction works.

Benchmarking. Benchmarking is increasingly being used in the WASH sector to monitor and compare WASH delivery systems and service levels achieved by these systems. Clearly, benchmarking processes can be improved if they take into account the life-cycle costs of achieving a certain level of service in any given context.

5.9.3 What is a life-cycle costs assessment?

WASH life-cycle costs assessment is a practical tool for assessing life-cycle costs. A life-cycle costs assessment identifies the different costs and cost drivers associated with achieving a certain level of sustainable and equitable services delivery in a specified area. A life-cycle costs assessment can also identify costs associated with externalities or activities outside the WASH sector, assessing or estimating the current scale and trends of each (disaggregated) cost and cost driver. Finally, a life-cycle costs assessment also helps in aggregating costs that reveal the total cost of sustainable and equitable services delivery for a certain service level, in a specified area.

A life-cycle costs assessment may be used as a stand-alone methodology or as part of water accounting (see Section 5.3). In either case, the main objective is to better inform decision making for the rehabilitation of old delivery systems and the planning for and operation of new systems. Findings of life-cycle costs assessments provide reliable up-to-date information to those responsible for financing delivery systems - whether these be funding agencies, revenue departments, service providers or the service users themselves.

5.9.4 What are the main types of life-cycle costs assessment?

The nature, design and scale of a life-cycle costs assessment should be based on the context and need that is to be addressed. Similar to water accounting, it is often best to carry out such an assessment in several phases of increasing complexity, with a first piloting or "back of an envelope" assessment that guides the subsequent development of more detailed and focused cycles of information collection and analysis.

Two types of life-cycle costs assessments are described below, namely, light (or rapid) and comprehensive. The types of assessments described represent the two extremes in a continuum of increasing complexity. However, in reality, a life-cycle costs assessment may be designed to fall anywhere along this continuum.

A **light or rapid life-cycle costs assessment** is based on an analysis of relatively and easily accessible secondary information. Participation of key stakeholders -- particularly in the consolidation and quality control of information and the identification of cost drivers -- is a key component. Analysis of the resulting information aims to be rigorous, but overall confidence in the outputs will be less than would be the case with a comprehensive assessment. The granularity of a light (or rapid) life-cycle costs assessment is typically low.

A **comprehensive life-cycle costs assessment** is based on an analysis of secondary information that has been updated, gap-filled, and ground truthed. Active participation of key stakeholders remains a key component across all aspects of this more comprehensive approach. The analysis of information aims to achieve a high-level of confidence in outputs, in terms of statistical significance and stakeholder support and/or consensus. The granularity of a comprehensive life-cycle costs assessment is typically high.

5.9.5 What are the main components of a life-cycle costs assessment?

Leaving aside costs relating to externalities, the main generic components or categories of a life-cycle costs assessment[11] are:

Box 4 Components of a life-cycle costs assessment

Capital expenditure - software and hardware (CapEx)	Capital invested in planning (i.e. software) and constructing (i.e. hardware) a WASH delivery system. Including costs of taking a light-IWRM approach to inter-sectoral planning and budgeting
Operating and minor maintenance expenditure (OpEx)	Recurrent expenditure on operating, managing and maintaining a WASH delivery system
Capital maintenance expenditure (CapManEx)	Expenditure on asset renewal, replacement and rehabilitation costs for a WASH delivery systems
Cost of capital (CoC)	Cost of financing a WASH delivery system, taking into account loan repayments and the cost of tying up capital

(Box 4 continued on next page)

[11] For a more detailed discussion of life-cycle costs assessment components, life-cycle costs and linkages with RIDA tables, see Fonseca, et al., (2010).

Expenditure on direct support (ExpDS)	Unit costs of post-construction activities aimed at supporting local-level stakeholders, users or user groups for a specified WASH delivery system
Expenditure on indirect support (ExpIDS)	Unit costs of macro-level support, planning and management of a WASH delivery system. Including also the costs of inter-sectoral dialogue and planning alignment

Source: Own elaboration, based on Fonseca, et al., (2010).

5.9.6 How can a life-cycle costs assessment best be structured?

Similar to water accounting, it is important to structure a life-cycle costs assessment. This ensures that the assessment produces balanced findings, that important components are not neglected or overlooked, and that staff involved do not become overwhelmed by large quantities of secondary information.

The RIDA framework provides valuable insight into structuring life-cycle costs assessments and, more specifically, to ensure that service provider and user costs are clearly differentiated and/or categorised. If a life-cycle costs assessment is used as part of a wider water accounting initiative, the RIDA framework is also helpful in providing possibilities to map and relate life-cycle costs to other aspects of a WASH delivery system (e.g. the institutional map, the technical supply system, etc). The application of two or more methodologies can both aid and improve the quality of analytical procedures and the presentation of outputs. Table 8 provides an indicative example of how merging a life-cycle costs assessment and a RIDA framework help further interrogate water supply, sanitation and hygiene services.

Table 8 Indicative example of Life-cycle costs assessment - RIDA structure for WASH services provision

WASH components	Resources	Infrastructure	Demand and Access
Water supply	Costs involved in sustainable provision of water resources of required quantity and quality	Costs incurred by service providers when constructing, operating and maintaining water supply infrastructure	Costs incurred by users who routinely access formal, informal and private water supply systems to meet demands (e.g. domestic, municipal, commercial, industrial, MUS, livestock uses)

(Table 8 continued on next page)

WASH components	Resources	Infrastructure	Demand and Access
Sanitation & Hygiene	Costs involved in protecting the quality of water resources from disposal of solid and liquid wastes	Cost incurred by service providers when constructing, operating and maintaining sanitation and environmental sanitation systems	WASH costs incurred by users who "self" provide sanitation systems and/or routinely utilise formal, informal and private solid and liquid disposal systems

Source: Own elaboration (2011).

5.9.7 Life-cycle costs assessments: getting started

Life-cycle costs assessments provide stakeholders with an opportunity to reach a shared understanding of the causes of WASH services delivery problems, albeit from an expenditure and or cost perspective. Where relevant, such assessments also provide stakeholders with an opportunity to identify causes and costs of externalities that lie outside the WASH sector. Ideally, the main responsibility for undertaking a life-cycle costs assessment rests within a multi-stakeholder platform. However, it is likely that relevant work is led by one or more members of the multi-stakeholder platform, or is contracted out to an organisation with appropriate skills.

Getting started with a life-cycle costs assessment involves the following generic activities[12]:

Specify the domain. Specify initial spatial and temporal boundaries for information collection. The spatial boundaries can be technical or institutional, for example, the area served by a multi-village supply system or an un-served peri-urban area or village. The temporal boundaries also cover time limits (past and future) when considering key trends. While the focus may be primarily at one particular level (e.g. intermediate), it is important to collect sufficient information at higher and lower levels. Doing so helps triangulate information and make judgements regarding, for example, conditions of service delivery to poor and marginal social groups.

Wider stakeholder process. Decide whether a life-cycle costs assessment is to be used as a stand-alone method or is made part of a wider stakeholder process aimed at promoting stakeholder dialogue and inter-sectoral planning and alignment. These processes could include: project cycle management, benchmarking, integrated water resources management or inter-sectoral budgeting using medium-term expenditure frameworks.

[12] Note that many of these activities are the same or similar to those needed to initiate water accounting.

Specify information needed. Information consolidation should be based on a needs assessment. Specify details of the information required, including the appropriate degree of disaggregation, the scale of maps, the granularity, and levels of precision.

Identify sources of information. Secondary sources of information include existing information collected by line departments or as part of earlier projects or programmes. Also decide on the type of primary information (i.e. new information) required to fill information gaps, quality control existing information, and bring existing information up to date.

Form a multidisciplinary team to carry out the work. In most cases a range of skills and experience will be needed to collect, quality control and analyse information on costs and WASH service levels. A high level of information management experience is highly desirable (e.g. GIS and databasing skills). Decide also on the level of specialist support (if any) and analytical tools that may be needed. When planning a life-cycle costs assessment, it is important to allow sufficient time for capacity building activities.

5.9.8 Life-cycle costs assessment process

Once the "getting started" step has been completed, it is possible to move on to the main life-cycle costs assessment process. Although there is no fixed formula or iterative sequence for the process, in generic terms there are six main phases:

Phase 1: Targeted awareness raising is vital if stakeholders are to become fully involved. Experience has shown that many national, state and intermediate level stakeholders may either be aware of or are already using unit cost information. However, in most cases, the concept of life-cycle costs is new. At the local level, particular attention has to be given to ensuring that the poor and other marginalised groups are aware of what is happening, and are able to participate and/or are sufficiently represented in meetings.

Phase 2: Institutional mapping is critical to ensuring that a life-cycle costs assessment takes account of the roles and responsibilities of different WASH stakeholders and, by association, the activities that should be costed as part of the assessment. Essentially, this phase revolves around building a complete understanding of the life-cycle costs components of WASH services delivery system(s) in a specified area.

Phase 3: Gathering information and quality control involves identifying and accessing existing (secondary) sources of information, carrying out quality control, and consolidating this information into an information base. Where necessary, additional primary data will also need to be collected and quality controlled. Triangulation of data from different sources and levels is useful to ensure internal consistency.

Phase 4: Data analysis (of current WASH services levels) investigates the costs of certain levels of sustainable and equitable services delivery. It is important to recognise that many users may use more than one service delivery system and, even so, their service levels may neither be equitable nor sustainable. Particular attention should be paid to trends, and whether or not service levels have a tendency to slip back. The aim of this phase is to get a good understanding of current levels of the life-cycle costs components, the influence of contextual factors and important cost drivers.

Phase 5: Data analysis (of future/planned WASH services levels) investigates how life-cycle costs expenditure patterns might be modified to improve WASH services and/or value for money. This analysis can be based on identifying gaps in expenditure patterns (e.g. no allocation for some life-cycle cost components), extrapolation of relationships between expenditure and service levels, and/or modelling. Outputs from this phase form the basis of future financing mechanisms and expenditure levels.

Phase 6: Dissemination of information to key stakeholders in formats that are most likely to inform decision making at any given institutional level.

5.9.9 Life-cycle costs assessment: lessons learnt?

Practical lessons learnt from the application of a life-cycle costs assessment include:

- Some users worry that findings from the application of a life-cycle costs assessment may serve as a precursor for introducing or increasing tariffs. This often results in non-participation or the falsification of information.
- Obtaining numerical information on all life-cycle cost components is not always easy. In such cases, it may be necessary to generate information by, for example, constituting expert panels.
- Official information on expenditure is not necessarily the same as the actual expenditure on different cost components. Hence, consideration should be given to using techniques such as value-for-money analysis or input tracking. These will provide an estimate of the percentage of expenditure that might be going astray.
- The life-cycle costs assessment method as described here provides a basis for standardisation that currently does not exist. In fact, large differences exist in published unit and life-cycle costs information that can primarily be attributed to the methodology used to calculate or estimate these costs.

5.10 Qualitative Information Systems (QIS)

5.10.1 What is QIS?

QIS is a fieldwork tool that is used primarily at the local level to obtain information on the perceptions and concerns of targeted groups or communities on a wide range of issues relating to WASH services delivery. Qualitative information is elicited from individuals or groups using an ordinal scoring system. Findings drawn from the statistical analysis and/or mapping of this information are then used to support stakeholder dialogue, planning processes and project management.

5.10.2 What are the main strengths of QIS?

The main strengths of QIS include:

- QIS provides a cost-effective, semi-quantitative means of evaluating the aggregated view (or perceptions) of stakeholders regarding, for example, the status of WASH services levels.
- QIS can be modified to collect information on a range of different issues or topics.
- QIS can be used to encourage stakeholder dialogue on the nature, severity and/or importance of WASH-related problems.
- QIS is a powerful tool for identifying possible discrepancies between official statistics and facts on the ground.
- QIS produces information that can be used to show the location and severity of WASH problems on maps.
- QIS can be used to monitor the progress and outcomes of a project in both space and time.

5.10.3 What are the constraints on or weaknesses of QIS?

Whilst QIS has many potential benefits and uses, there are potential risks and constraints that need to be recognised and mitigated. These include:

- The quality of QIS information is highly dependent on the diligence and facilitation skills of field staff.
- There is a risk that field staff can introduce their own biases as a consequence of the way in which they introduce and facilitate the ordinal scoring system.

- There is a risk that stakeholders will exaggerate or modify their responses. For example, farmers might exaggerate their water supply problems to justify demands for increased allocations.
- As with all PRA methods, responses are sometimes influenced by transitory factors. For example, responses may differ before and after a period of drought.
- Unless specific steps are taken, the process can be dominated by more articulate and confident stakeholders.

5.10.4 QIS: getting started

The effectiveness of QIS assessments greatly depends on expert facilitation, good supervision of field teams, and working within a team whose members can speak the local language(s), understand local customs, politics and other factors that may impact upon the results of the assessment. Achieving gender balance in field teams is also highly desirable.

As with most participatory rural appraisal (PRA) fieldwork, QIS fieldwork has to be organised to fit in with the availability of key informants. This often involves holding meetings during evenings or outside normal working hours. It is also important that meetings are held at times when women are able to participate.

Given the need for early starts and late finishes, adequate transport must be provided to get teams to and from villages or towns where the QIS is taking place. In most cases, QIS teams need to have access to laptop computers so that data entry can be completed during or soon after the fieldwork. Confusion is more easily avoided if data quality problems are identified quickly and followed up immediately with key informants and, if necessary, further field work.

5.10.5 QIS process

In the method described below, the first four steps comprise the preparation phase of QIS. Data collection takes place in steps 5 and 6, with steps 7 and 8 covering work on analysis and interpretation of the data.

Step 1: Planning. A needs assessment is the starting point for deciding whether QIS is the appropriate tool to use. The following questions should be considered: What information is required? Who requires this information? At what spatial and/or societal scale should the information be collected? What resources are available? Who will take responsibility for the assessment? Is QIS the most cost-effective method of collecting this information?

Step 2: Mobilisation, capacity development and preparation of QIS field formats. Within this step, the QIS team(s) is assembled and their knowledge and skills in using

QIS techniques are checked and improved, so that there will be consistency in the way in which team members elicit information. A 'team' may be small or quite large comprising of, for example, a supervisor with good PRA and facilitation skills, male and female field staff, and someone to process and quality control the data. Preparatory discussions cover issues to be assessed, indicators being used, the ordinal scales, and the QIS field formats. Development of these formats usually involves role play and practice interviews among team members.

Step 3: Field testing of QIS formats. The QIS formats comprising of questions, indicators and ordinal scores usually require two rounds of field testing. The first round is to identify the problems to be rectified in the field formats, and the second is to make sure the revised formats are suitable for the survey.

Step 4: Informing local officials and key informants. QIS assessments in a village or a town should be planned well in advance, and in consultation with local officials and key informants. Local officials and key informants should be provided with information on the aims of the field survey, as well as the opportunity to raise questions on the assessment. Dates and time of actual surveys should be fixed at a time most convenient for key informants. Care should also be taken to avoid festivals or important events in the village (e.g. marriages).

Step 5: QIS assessments A QIS assessment at field level usually starts with a meeting with officials, elders, teachers and other key informants to discuss the purpose of the assessment, obtain basic information about the village, and plan for the assessment. Thereafter, QIS data can be collected as part of key informant interviews, focus group discussions and/or transect walks. At the end of the assessment, a village meeting is held to provide feedback, and to cross-check the main findings.

Step 6: Scoring The QIS formats are used in focus group discussions or key informant interviews. Groups or individuals can be asked to fill in the scores without direct assistance. Alternatively, the process can be facilitated and scores can be recorded by a field team member who may also document qualitative reasons for the scores that are given.

Step 7: Data processing Field data, including scores, is entered on to a computer along with relevant field notes. Simple quality control procedures need to be followed (e.g. cross-verification or triangulation of data by the field teams).

Step 8: Report writing and dissemination Data analysis should focus on providing the information identified in Step 1 in formats that can be understood by those identified as needing it. As part of good fieldwork practice, a summary of the survey outputs should be fed back to those who participated in the survey.

5.10.6 Presentation of findings

Results can be presented in a variety of forms from tables and bar graphs to GIS layouts. Table 9 is an example of an ordinal scoring format that was developed to assess the participation of women in village-level decision making across fifty villages in Kalyandurg Sub-district, Andhra Pradesh, India. Findings from this survey are also presented in Figure 5 (see next page).

Table 9 Example of a QIS ordinal scoring format

Ordinal Score	Qualitative Option	Village score
0	Women are not involved in community decision making	—
25	Women are in committees but do not attend	
50	Women attend meetings but mostly let men take major decisions	
75	Women attend and participate but cannot influence major decisions	
100	Women attend, participate and are able to influence major decisions	

Source: Rama Mohan Rao, et al., 2003.

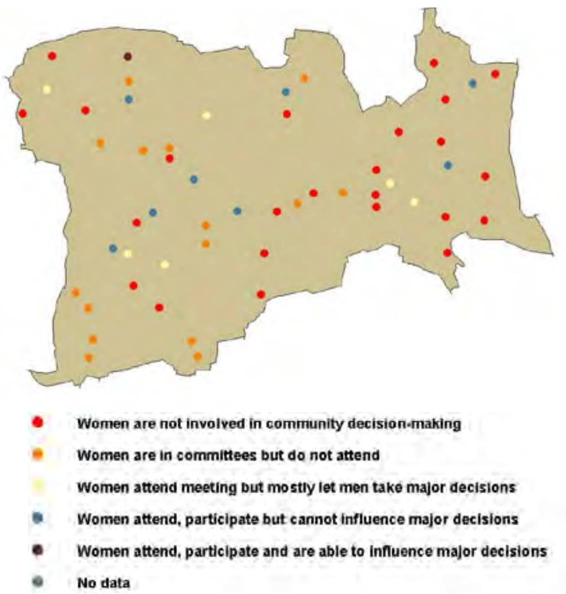

Figure 5 An example of presentation of QIS findings on a map
Source: Rama Mohan Rao, et al., 2003.

5.10.7 QIS lessons learnt[13]

- It is often advantageous for the field team to include some members who come from, or have familiarity with, the area.
- When planning a QIS, it may be necessary to organise an awareness raising session for officials and informants who will help in the process, or whose permission is required for the QIS to take place.
- In terms of water accounting, it is often beneficial if QIS formats and the scale of QIS surveys are aligned with hard information that is collected from other sources.

5.11 Scenario building

5.11.1 What is scenario building?

Nothing is more obvious than the unpredictability of the future (Ratcliffe, 2008). In planning processes, the sector is continuously confronted with the dilemma that all reliable knowledge stems from the past, whilst all decisions that need to be made are for the future. Arguably, uncertainty in the WASH sector has now become so pronounced as to render futile, if not counterproductive, planning processes that are based on probabilities and the extrapolation of current trends. Or put another way, unique forecasts of factors influencing the provision of and demand for WASH services delivery can and should no longer be relied upon.

So, what can we do? One option is to use scenarios and scenario building as an integral part of planning processes. The main purpose of scenario building is to enable a learning alliance or a stakeholder platform to identify, evaluate and take explicit account of a whole range of uncertain factors that might either support or derail strategies and plans that are aimed at achieving a shared vision.

Scenario building is essentially a team exercise that can help a group of stakeholders to come to terms with uncertainty and risk in a planning process. In particular, scenarios can be used to identify the most uncertain and most important factors that are outside the direct control of stakeholders. Experience has shown that it is these uncontrollable factors that are more likely to disrupt plans rather than factors that, although very important, are predictable and under the control of stakeholders tasked with implementing strategies and plans.

[13] For a more general discussion on the methodology, see James, Postma and Otte (2003).

Scenario building forces stakeholders to confront key beliefs and challenge conventional wisdom. It forces stakeholders to think creatively and systematically engage with a multitude of inter-sectoral issues and factors that, in the future, may have an increasingly important impact on the WASH sector (e.g. peak oil[14], increased demand for agricultural commodities, climate change).

Whilst scenario building is used routinely throughout the fields of industry, commerce and government, its use in the WASH sector is still relatively limited. In these other sectors, scenario building is no longer regarded as gimmick but as a methodology that is taken very seriously, the result being that scenario building is an integral part of planning processes and time and other resources are routinely allocated to develop the skills required to construct and use scenarios effectively.

Scenario building can be a very creative and enjoyable process that inspires stakeholders to think seriously about uncertainty and risk and to recognise that increasingly the future rarely resembles the past. Adaptation to change is feasible if the change processes are slow and predictable (i.e. based on current trends or frequencies of occurrence). However, problems really start to kick in when change is rapid and unpredictable. This is when scenario building shows its real worth to a strategy development and/or planning process.

5.11.2 Scenario building: getting started

Facilitation. In most cases, scenario building requires facilitation that includes organising and mediating stakeholder meetings and workshops, documenting the outcomes of these events and circulating resulting materials to the participants. Ideally, facilitators will have a good knowledge of the water sector and expertise in the use of facilitation techniques.

Specialist support. Is often needed to prepare materials for meetings and workshops. These materials can include reviews and copies of existing scenarios for the area or domain of interest. Specialist support may also be necessary to ensure that scenarios are internally consistent and based on accurate evidence and knowledge (rather than hearsay and intuition).

High-level support. For the scenario building to have credibility and legitimacy, the group of stakeholders, learning alliance or stakeholder platforms will need to involve, or at least have the support of, democratically-elected representatives.

[14] *Peak oil* is the point in time when the maximum rate of global petroleum production is reached, after which the rate of production enters its terminal decline.

Marginalised groups. Similarly, the group of stakeholders, learning alliance or stakeholder platform should be gender aware and proactive in involving or representing marginalised social groups.

5.11.3 Scenario building process

Although scenario building can be carried out as a stand-alone activity, it is normally used as part of a planning process. Ideally, scenario building follows the development of a shared vision and an initial assessment of the status of water resources and trends in water supply demand in an area or domain of interest. There are many different methodologies that can be used to build scenarios, each with their own advantages and disadvantages. However, a generic stepwise approach to scenario building is as follows:

Step 1: Brainstorm factors. As part of a card exercise in a stakeholder workshop, brainstorm all the factors that will affect achieving a shared vision. This brainstorming should be wide ranging. During this step, it is often useful to ask stakeholders to consider factors that had a bearing on the success or failure of on-going or completed projects or programmes. At the end of this brainstorming, ask stakeholders to discuss whether some factors should be discarded on the basis that they have no relevance to the achievement of the vision, or to the area or domain of interest.

Step 2: Separate the factors into local and external factors. As a continuation of the card exercise in Step 1 (i.e. using the same set of cards), separate the factors into local and external factors. *Local factors* are those that can be controlled or mitigated in some way by the stakeholders themselves (e.g. lack of skill or capacity can be overcome by organising a capacity building programme). *External factors* are those that are outside the control of the stakeholders (e.g. climate change, global economic trends). As the difference between these two types of factors can be fuzzy, it is best not to be overly dogmatic. If it goes well, this discussion can be highly illuminating for stakeholders because it helps them to differentiate between the perceived and actual boundaries on the control that they may have over WASH services provision.

Step 3: Rank external factors according to importance and uncertainty. Using the matrix shown in Figure 6 (on next page), classify external factors according to their level of importance and uncertainty. Permutations of factors in the upper-right quadrant (i.e. the more important and more uncertain factors) will be central to building scenarios. On the basis of discussion, it is preferable to limit these more important, more uncertain factors to a manageable number (e.g. two or three), as this reduces the number of possible permutations that will be used in building scenarios. It is advisable to take time over this exercise because strong differences of opinions can occur. If it is facilitated well, this exercise provides an opportunity for lively discussion around these differences of opinion and, over time, for consensus to be reached.

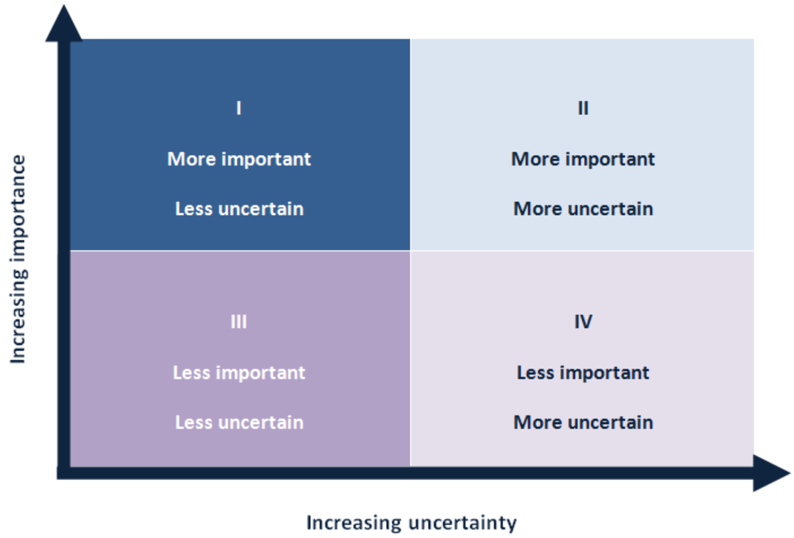

Figure 6 **Matrix for prioritising external factors according to importance and uncertainty**
Source: Schwartz (1991).

Step 4: Agree on the states of external factors. Discuss and set different future states for each of the "more important, more uncertain" external factors that were selected in Step 3. These states should be the realistic upper and lower limits of these factors at a specified time in the future[15]. The values can be set on the basis of stakeholder perception, expert opinion, rigorous statistical analysis[16] or a combination of all three. In most cases, there is merit in adopting upper and lower limits of states that have wider government, scientific and/or public recognition[17].

Step 5: Create outline scenarios. Outline scenarios are created by taking all possible combinations of the states of the selected external factors. To illustrate, if two external factors have been selected, each with two states, the number of outline scenarios will be four. If three external factors have been selected, each with two states, the number of outline scenarios will be eight.

It is common to only use two more important, more uncertain factors when creating scenarios. In the likely event that stakeholders agree that more factors should be

[15] Some scenario builders argue the case for "stretch scenarios" that, for example, do not cut the tails of probability distributions. On the basis that risk and probability are not the same thing and the risk of an event is equal to its probability times its magnitude, a low probability event can still be disastrous if its effects are large enough (Taleb, 2007; Roxburgh, 2009).
[16] For example: analysing probability distributions relating to the factor of interest.
[17] Some examples include economic growth forecasts made by the Organisation for Economic Co-operation and Development (OECD) and climate change forecasts detailed by the Intergovernmental Panel on Climate Change (IPCC).

included, one approach is to create multiple two-by-two combinations of, for example, four or five factors. At the very least, this provides a basis for simplification and reducing the number of permutations to a manageable number. More positively, building and working with a number of two-by-two permutations of factors can lead to interesting discussions and insights (Roxburgh, 2009).

Step 6: Create narrative scenarios. A stakeholder workshop concludes with the appointment of an individual or a group of individuals that are given the responsibility of turning selected permutations or outline scenarios into narratives (i.e. narrative scenarios). This is achieved by adding a background story to each of the outline scenarios. This background story should be based partly on the less important and less uncertain external factors that were identified in Step 3. The background story should also use information on the area or domain of interest.

Step 7: Naming the scenarios. Select evocative and memorable names for each scenario that represent the essential logic for each scenario. Meaningful and vivid names stand a better chance of being accepted, remembered and used by stakeholders during planning processes. It is best, however, to avoid using names such as "good", "bad" or "most likely" because the strength of a good set of scenarios is that each scenario is plausible. Or put another way, all scenarios should be valid as possible descriptions of the future (although not necessarily equally likely to occur). Therefore, a robust WASH services delivery strategy must enable the vision to be achieved under all of the scenarios.

Step 8: Test and evaluate the scenarios. Review available information to check the validity of the descriptions of external factors and the values that have been given to the states of the most important and most uncertain factors. Check that internal consistency across individual scenarios is achieved through the review of published information or by using modelling techniques. Finally, disseminate the scenarios to the groups of stakeholders and specialists and ask for feedback on their plausibility and validity.

5.11.4 What are the characteristics of a good scenario?

It is surprisingly hard to create good scenarios (Roxburgh, 2009). Although there are many different processes that can be used for scenario building, scenarios that have the potential to improve planning process have certain common characteristics. These include:

- Scenarios have the ownership of the stakeholders, and the narratives have a local flavour.
- Scenarios have a logical structure and are internally consistent.

- Scenarios are equally plausible and build upon existing information and knowledge.
- Scenarios present information that is a mix of narrative and numerical data. As such, they can be used for specialist activities (e.g. as a basis for modelling) and non-specialist activities (e.g. as a basis for awareness campaigns).
- Whilst the scenarios may take account of a wide range of factors, they give particular weight to the most important and most uncertain factors that are outside the control of the stakeholders, who are ultimately responsible for implementing the resulting plan.
- In the context of a planning process, results arising from scenario building are expected to challenge and inspire people to depart from traditional ideas that are no longer applicable to the current environs, including those that perpetuate prejudices and biases.
- In the context of a planning process, good scenarios always challenge and surprise - bad ones merely confirm current conceptions and perpetuate personal prejudices.

5.11.5 Scenario building: challenges and tensions

A well-crafted set of scenarios is said to lure decision-makers outside the comfort and familiarity of their traditional mind sets. In so doing, a number of challenges and tensions can come up. According to Ratcliffe (2008), these include:

- **Present versus future.** Decision-makers have to respect and reconcile simultaneously present realities with the logic of plausible futures. This requires a good understanding and analysis of drivers of change.
- **Closed versus open-ended.** Scenarios can be constructed with very specific strategy decisions in mind, or they may be developed to help decide which strategy decisions should be analysed.
- **Grounded versus imaginative.** Good scenarios are both thoroughly researched and thoroughly imagined, whilst bad scenarios rely too heavily on uninformed speculation and are poorly researched. However, a balance between detailed study and unfettered creativity needs to be struck.
- **Intellectual versus emotional.** In a similar vein, scenarios are necessarily an intellectual and analytical activity, but they must also attempt to capture the emotions of those who develop and implement them.

- **Advocacy versus dialogue.** Good scenarios are likely to be built when individuals advocate their point of view and argue the importance of different factors. However, once scenarios have been selected, a more reasoned dialogue is needed among all those concerned.

- **Scepticism versus expertise.** Expertise is essential in the analytical process of scenario building, but because the future can be so different to the past, a healthy scepticism should be maintained about the pronouncements, judgements and assessments of experts. This scepticism should compel decision-makers to reflect critically upon each scenario's logic and plausibility.

- **Probability versus plausibility.** One of the most contentious debates concerning the use and development of scenarios centres on the assignment of probability to the final scenarios. One school of thought argues that not assigning probabilities is a "cop-out" because probabilities give decision-makers important information on which to base their strategies. Another school of thought asserts that assigning probabilities is a "hangover" from the days when forecasters really thought they could predict the future.

5.11.6 Scenario building: lessons learnt

Practical lessons learnt from scenario building exercises include:

- Separating local from external factors is not easy. Stakeholders typically focus on the former.

- Prolonged facilitation is sometimes needed to encourage stakeholders to have the confidence to consider and voice opinions on external factors.

- Developing scenarios is as much an art as it is a science. Ideally, those tasked with writing narrative scenarios should have journalistic or creative writing skills.

- Similarly, the presentation of scenarios in meetings can be made more interesting and thought-provoking if some creativity is used. For example, by asking stakeholders (or even professional actors) to enact scenarios.

- It is best not to rush scenario building. In the context of a multi-stakeholder planning process, as much value can be gained from discussions during the scenario building as from the final outputs.

- There is always a tendency to give specialists the leading role in a scenario building workshop when the role of specialists should be limited to a supportive one.

- It takes quite some time before stakeholders (and even facilitators) start to appreciate the value of scenario building as part of a planning process. Often, quite senior-level champions are needed to overcome the initial reluctance of junior or less confident stakeholders to engage in the process.

- It is important to listen to contrary opinions during scenario building and not to base the scenarios entirely on consensus (or group think).
- Finally, scenario building is not about "knowing the future", nor about always being right; it is about trying to minimise the chances of being seriously wrong.

5.12 Strategy development (based on visioning and scenario building)

5.12.1 What are the aims of strategy development?

The main aims of strategy development based on visioning and scenario building are to:

- Develop robust and adaptable strategies that have the potential to achieve a shared vision under a whole range of different scenarios (i.e. different futures).
- Encourage key stakeholders to take a leading role in strategy development processes to have a high-level of ownership of the process, outputs and outcomes.

5.12.2 Overview of the strategy development process

Figure 7 (on next page) provides a schematic overview of the concept of strategy development based on visioning and scenario building. At its simplest, the approach involves three phases. First, stakeholders develop a shared vision of the water services and environment that they would like to achieve at some specified time in the future. Second, stakeholders develop a set of plausible (although not necessarily equally likely) scenarios that describe different futures. Third, an overall strategy is developed that integrates various components with the potential to achieve a shared vision regardless of which scenario, over time, turns out to be closest to reality. Depending on the context and the time frame of a vision, this overall strategy may, in practice, be simple or very complicated. Each of these phases is described below in more detail.

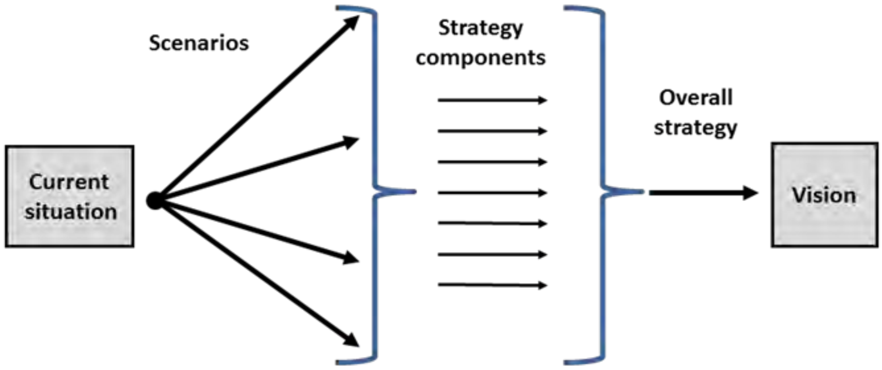

Figure 7 **Strategy development based on visioning and scenario building**
Source: Own elaboration (2011).

The advantages of this approach, compared to more standard approaches to strategy development, are many and varied. The use of visioning and scenario building stimulates social and organisational learning and provides a process for enhancing stakeholders' understanding of how to prepare for and manage change, risk and uncertainty. Equally important, the approach helps stakeholders think creatively about important and uncertain factors over which they have no or very limited control. The net result being that stakeholders are less likely to fear or ignore these factors, and are more likely to consider how they could thrive in a range of future settings, some of which may be strikingly different to anything that they have ever experienced.

The high level of attention that strategy development (based on visioning and scenario building) gives to uncertainty, risk and change makes it entirely consistent with principles of adaptive management. Adaptive management is based on the recognition that in a complex and rapidly changing situation there can never be sufficient information to reach a settled "optimum" decision. Hence, the emphasis is on flexible planning backed by strong monitoring and information management systems that allow constant adaptation and the upgrading of plans and activities.

5.12.3 Strategy development: getting started

Visioning, scenario building and water accounting are pre-requisites. Strategy development based on visioning and scenario building should only start once initial visioning, scenario building and a process of water accounting have been completed. Ideally, these activities will also have included the establishment of the stakeholder platform or learning alliance that will take a central role in strategy development.

Facilitation. The approach to strategy development described here requires the active support of a facilitator or a facilitation team over a period of many months. Ideally, facilitators will have a good knowledge of the water sector and will have training and experience in the use of a whole range of facilitation techniques.

Specialist interdisciplinary support. Is usually needed to prepare materials for strategy development meetings and workshops. These materials should include reviews, descriptions and rigorous assessments of potential strategy options and opportunities. Rather than taking responsibility for strategy development, the role of specialists is to support stakeholder dialogue and, more specifically, to help stakeholders understand the potential implications and trade-offs associated with different strategy options.

High-level support. To obtain credibility and legitimacy, a strategy development process should involve and/or have the active support of democratically-elected representatives.

Marginalised groups. Similarly, to gain credibility and legitimacy, the learning alliance or stakeholder platform should be gender aware and proactive in involving or representing marginalised social groups.

5.12.4 Strategy development process

The following are a set of generic steps that can be used to develop an overall strategy development process that is based on visioning and scenario building. The exact sequence of steps, number of iterations and the time that might be needed will depend on the context. If the process is to produce a robust and adaptable strategy, it is crucial that each step involves stakeholder dialogue that is structured around achieving the shared vision under the whole range of scenarios.

Step 1: Identify components of an overall strategy. In preparation for and/or during a learning alliance meeting, brainstorm and list practical options and opportunities that could become components of an overall strategy and that will have the potential to achieve the common vision. Suggestions for these strategy components are likely to originate from many sources. Some will be based on existing practices, while others might be entirely new to the stakeholders in the area of interest.

Step 2: Evaluate each strategy component. Assess the social, technical, political, economic and environmental viability and acceptability of each strategy component, especially those that are new to the stakeholders. This assessment is likely to be carried out by specialists working with stakeholders who may have a particular interest in some or all of the strategy components. The assessment should use a range of techniques (including modelling) but, regardless of the technique, specific consideration should be given to whether the strategy component is well matched to the challenges and context of the area of interest. By the end of this step, a range of strategy components should have been rigorously assessed and either rejected or adapted to the specific context of the area of interest.

Step 3: Identify specific risks and constraints. For each strategy component selected and adapted in Step 2, identify the risks or constraints that could influence the potential for strategy components to achieve the vision (or parts of the vision). In most cases, these factors will already have been identified and ranked as one step of the scenario building process. If so, this "scenario building" list of factors can be used as a starting point for carrying out this step. Finally, check whether there are risks that certain strategy components, if implemented, will impact negatively on the viability of other strategy components, on water users, or the environment outside the area of interest. At the same time, attention should also be given to identifying whether particular synergies could result from implementing certain sets of strategy components as part of an overall strategy. By the end of this step, additional strategy components will have been rejected, synergies between some strategy components will have been identified and the potential impacts of strategy components outside the area of interest will have been elaborated.

Step 4: Link strategy components to relevant parts of the vision. Using a disaggregated form of the vision as a starting point, link and group strategy components to relevant parts of the vision.

Step 5: Evaluate the utility of strategy components against the disaggregated vision under all scenarios. For each part of the disaggregated vision, assess whether the linked group of strategy components has the potential to achieve this part of the vision under all the scenarios. Modelling and other analytical techniques can support this process. The result of this analysis, which may take some time, should be a summary table.

Step 6: Refine strategy components. If analysis indicates that groups of strategy components are not able to achieve parts of the vision under all scenarios, try refining the group of strategy components or consider adding strategies that are linked specifically to achieving the part of the vision under certain scenarios. If this fails, there are two possible courses of action. The first is to revise the part of the vision to a form that is realistic and may be achieved. The second is to proceed in full knowledge that the vision or parts of the vision will not be achieved under some scenarios. This second "gambler's" option is not recommended.

Step 7: Combine strategy elements to produce versions of an overall strategy. By combining different combinations of strategy elements, create a number of overall strategies. Continuously check that these overall strategies have the potential to achieve the vision or revised vision. Particular attention should be given in this step to the financial and other resources that will be needed, and whether effective implementation of an overall strategy will necessitate major changes in institutional arrangements and governance systems. Particular attention should also be given to identifying and, where possible, quantifying whether a strategy is pro-poor and at the very least gender sensitive. By the end of this step a number of different overall strategies will have been outlined and the relative costs, benefits, merits and trade-offs of the strategies will have been tabulated.

Step 8: Select and refine an overall strategy. Selection of the overall strategy should be based on stakeholder dialogue and, if appropriate, a wider consultative process. During this step, the details of the overall strategy need to be elaborated and particular attention needs to be given to issues related to environmental, institutional and social sustainability, and whether life-cycle costs have been covered adequately. Finally, particular attention should be given to an integrity assessment aimed at ensuring that the strategy includes measures that achieve good value for money and minimise the risks of benefits being captured by elites or more privileged social groups.

Step 9: Start the planning process. As the planning progresses, new people and organisations will become involved, at times as part of a tendering process. As a result, new ideas may develop and added challenges to the overall strategy identified. This may result in some steps of the strategy development process being repeated.

5.12.5 Strategy development: challenges and tensions

A successful strategy development process builds consensus amongst stakeholders, develops a robust and adaptable strategy and secures the support of politicians, the media and civil society. Although the concept of strategy development based on visioning and scenario building is simple, a number of challenges and tensions often arise when using the technique. These include:

Lack of information. In most cases, there is insufficient quality information to rigorously assess all the components of an overall strategy. Collecting additional information takes time and money that is rarely available. Use of adaptive management principles can help overcome this problem but even so, decisions may have to be based more on judgement than evidence. Hence, there is often a tension between those who propose more studies and those who want to move ahead quickly.

Evidence-informed decision making. Strategy development in the water sector is often based on accepted wisdom, myths or folklore[18]. The challenge in such situations is to encourage stakeholders to put their faith in evidence rather than intuition.

Internalising external factors. Regardless of the approach taken to strategy development, important and uncertain factors outside the immediate control of stakeholders always have a high potential to derail strategies. The challenge is

[18] See RWSN (2009) for an interesting discussion on rural water supply myths.

therefore for stakeholders, as part of the overall strategy, to seek to increase their level of influence or control over these factors.

Spatial and temporal scales. It is rare for a strategy in the water sector to have no negative trade-offs at all. Or put another way, any changes in the way water is allocated or managed tends to result in winners and losers, particularly if a holistic multi-scalar approach is taken to considering supply and demand. The challenge is to identify and minimise these trade-offs.

Acceptable levels of risk. The methodology described here ensures that risk and uncertainty are considered during the strategy development process. However, this does not mean that the resulting strategies are devoid of risk. Many of the decisions that have to be taken during the strategy development process involve decisions on acceptable levels of risk. These decisions are invariably political in nature and, as such, the challenge is to make sure that a democratic process is followed in reaching decisions.

Special interest groups. The method described encourages the active involvement of special interest groups. However, the involvement of these groups can lead to tensions because they have a habit of disrupting IWRM processes especially if they feel that their topic of interest is not being given sufficient attention.

5.12.6 Strategy development: lessons learnt

Generic lessons learnt from using strategy development based on visioning and scenario building include:

- To ensure that there is rigour in the assessment of groups of strategy components, it is important that the vision contains specific numerical targets and/or acceptable limits for measurable parameters.
- The dividing line between strategy development and planning can be rather fuzzy. Even so, it is important in strategy development not to get drawn into the level of detail that is required in planning.
- Simple flexible modelling systems (e.g. Bayesian Networks) can improve the quality of the assessment of strategy components.
- It is usually best to avoid including strategy components in a vision. Ideally, a vision should focus on outcomes and strategy components on achievement of these outcomes. This reduces the risk of circular arguments.
- It is absolutely crucial that some scepticism is used when assessing strategy components. The approach to strategy development described here is the antithesis of a “one size fits all” approach that is preferred by many organisations.

As such, the initial view taken by assessors should be that strategy components will not work in every technical and societal setting unless proven otherwise.

- Finally, it usually takes quite some time for potential users to appreciate the relative benefits of the approach described here. Hence, resistance to change from more traditional methodologies can be expected.

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Glossary

Adaptation (to climate variability and change): Policies, actions and other initiatives designed to limit the potential adverse impacts arising from climate variability and change (including extreme events), thereby maximising positive consequences.

Climate: Average weather and its variability over a period of time, ranging from months to millions of years. The World Meteorological Organization standard is a 30-year average. "*Climate is what you expect, weather is what you get*."

Climate change: A change in the climate's mean and variability for an extended period of decades, or more.

Climate extreme: A climatic event that is rare within a reference statistical distribution for a specified location. Typically, "rare" is interpreted as an event that is below the 10th percentile or above the 90th percentile.

Climate forcing (also known as radiative forcing): The imbalance in the Earth's energy budget resulting from, for example, changes in the energy received from the sun, the amounts or characteristics of greenhouse gases and particles, and/or changes in the nature of the Earth's surface.

Climate model: A mathematical representation of the climate system based on its physical, chemical and biological components, in the form of a computer programme.

Climate variability: Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), and/or to variations in natural or anthropogenic external forcing (external variability).

Critical threshold: The point in a system at which sudden or rapid change occurs.

Enabling environment: Attitudes, policies and practices that stimulate and support effective and efficient functioning of organisations and individuals.

Global warming: A rise in the Earth's temperature, often used with respect to the observed increase since the early 20th century.

Greenhouse gases: Gases in the atmosphere, which absorb thermal infra-red radiation emitted by the Earth's surface, the atmosphere and clouds (e.g. water vapour, carbon dioxide, methane and nitrous oxide).

Ground-truthing: The process of checking secondary or remotely-sensed information by conducting field visits to verify facts on the ground.

Hard information: Scientific knowledge and technical or bio-physical information that is often quantitative in nature.

Hot spots: Geographical locations where climatic conditions or climate change are projected to be particularly severe.

Incremental cost (of adaptation): The additional costs arising from reducing climate risks through adaptation, when preparing for and implementing a policy, plan, or action.

Intergovernmental Panel on Climate Change (IPCC): The IPCC was established jointly by the United Nations Environment Programme and the World Meteorological Organization in 1988. The purpose of the IPCC is to assess information in the scientific and technical literature related to all significant components of the issue of climate change.

Learning alliance: A learning alliance is a group of individuals or organisations with a shared interest in innovation and the scaling-up of innovation, in a topic of mutual interest.

Life-cycle costs (LCC): Life-cycle costs represent the aggregate costs of ensuring the delivery of adequate, equitable and sustainable WASH services to a population in a specified area.

Likelihood: The statistical probability of a given event occurring within a specified period of time.

Mainstreaming (of adaptation): The effective integration of adaptation activities into the preparation and implementation of policies, plans, and other instruments or processes concerned with WASH service delivery, economic development, social progress, and/or environmental protection.

Maladaptation: Action or investment that enhances vulnerability to climate change impacts rather than reducing them.

Master Plan: A comprehensive or far-reaching plan of action.

Mitigation (of climate change): Policies, actions, and other initiatives that reduce the net emissions of greenhouse gases that cause climate change through global warming.

No or low regrets: Refers to policies, plans, or actions that would generate net social benefits whether or not climate change occurs.

Optimal ignorance: Optimal ignorance is understanding the difference between what is worth knowing and what is not. This avoids the collection of too much irrelevant data. Appropriate imprecision recognises that in conventional assessments, much of the information collected has a degree of precision that is unnecessary and/or is inconsistent (in terms of precision) with other information that is being collected.

Resilience: The ability of a social or natural system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity of self-organisation and the capacity to adapt to stress and change.

Return period (climate change): The average length of time between the occurrences of a specified climatic or hydrological event.

Risk: The combination of the probability a hazardous event may occur, and the impact or consequence of that event.

Risk assessment: The structured analysis of hazards and impacts to provide information for decision making. Risk assessment usually relates to a particular *exposure unit* which may take the form of an individual, the population of a specified area, infrastructure in a specified area etc. The process usually involves identifying hazards that could have an impact, assessing the likelihoods and severities of impacts, and assessing the significance of the risk, which is usually related to the probability multiplied by the severity of the impact.

Sea-level change: Trends and other systematic changes in mean sea level, persisting for an extended period, typically decades or longer.

Sea-level rise (fall): An increase (or decrease) in the mean level of the ocean, persisting for an extended period, typically decades or longer.

Soft information: Societal information, expert opinion and/or perceptions which are usually qualitative in nature.

Stakeholder platform: A stakeholder platform provides a forum for stakeholder dialogue, conflict resolution and integrated planning. A stakeholder platform usually takes the form of a committee that meets routinely.

Strategy: A strategy is a medium to long-term planning framework within which specific activities are described and plans implemented. Over time, an effective strategy should lead to a vision being achieved.

Uncertainty: An expression of the degree to which a value (e.g. the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement over what is known or even knowable. Uncertainty may arise from many sources, such as quantifiable errors in data, or projections of human behaviour. Uncertainty can be represented by quantitative measures or by qualitative statements.

Vulnerability (to climate variability and change): The extent to which a natural or human system is susceptible to sustaining damage resulting from climate variability and change, despite human actions to moderate or offset such damage. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Weather: Describes atmospheric conditions at a particular time and place in terms of air temperature, pressure, humidity, wind speed and precipitation.

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